

BULLETIN UNIVERSITY OF MONTANA,
No. 10.
BIOLOGICAL SERIES No. 3.

A Biological Reconnoissance

IN THE VICINITY OF

FLATHEAD LAKE

BY

MORTON J. ELROD.

Professor of Biology, University of Montana, Director University of Montana Biological Station,
President Montana Academy of Sciences, Arts and Letters.

Prepared at the
UNIVERSITY OF MONTANA BIOLOGICAL STATION,
BIGFORK, MONT.

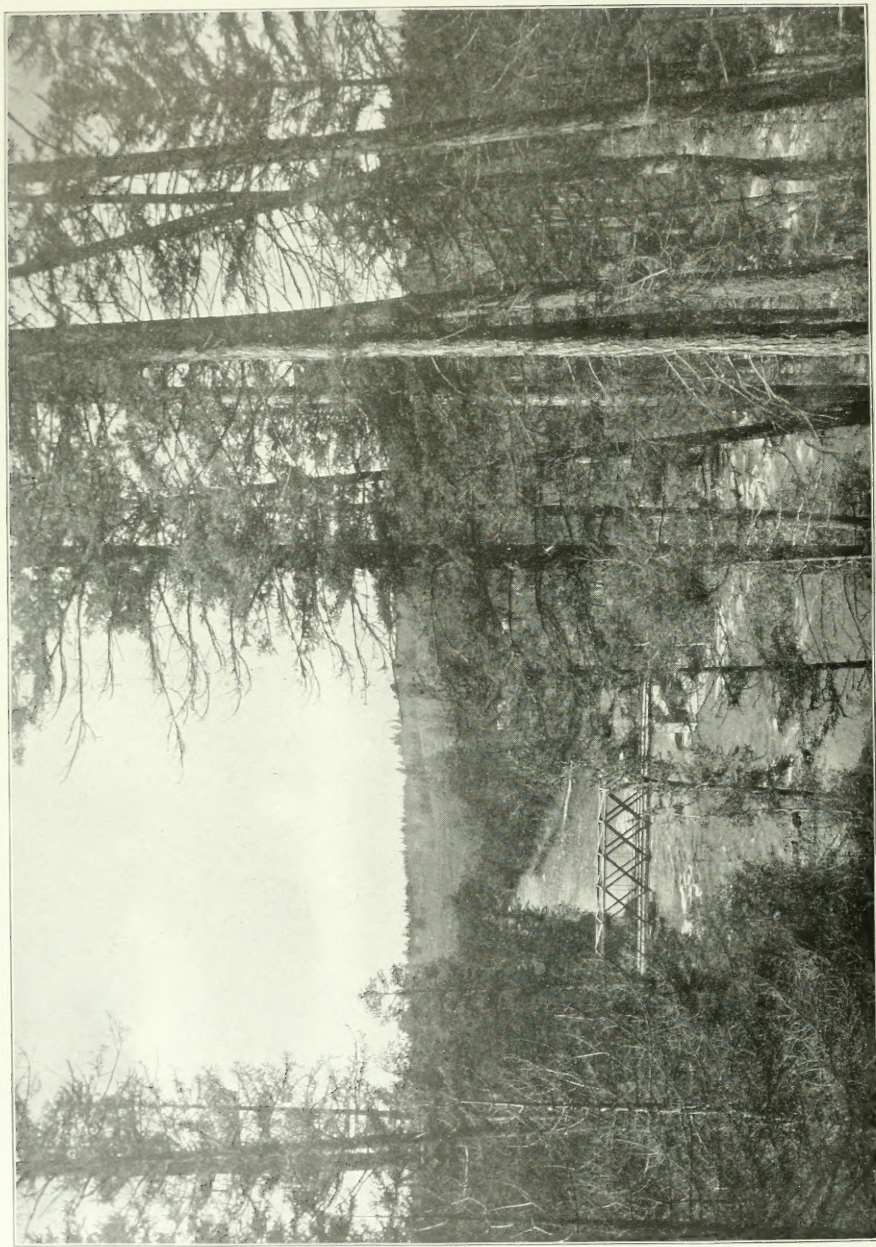
University of Montana, Missoula, Mont., U. S. A.

1902.





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Site of the University of Montana Biological Station, from the bluff on Swan River. The Laboratory is on the right beyond the bridge. The river turns to the left in the distance and flows into Flathead Lake. On the left are the Helena Club grounds. The view is west.

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Introduction.

The material presented in this bulletin represents the work of four seasons in the region under discussion. The bulletin is not intended as a dissertation on a technical subject. The notes presented are given with the idea (1) of describing a region in which considerable work has been done, and in which more will be done; and (2) to indicate to future collectors in the state regions where collecting may be carried on to advantage, and some of the finds to be expected.

The material collected is being worked over as rapidly as time will permit, and in due time technical papers will be presented. Nearly 1,500 shells of the species *Pyramidula strigosa* have been gathered, from altitudes ranging from 2,300 feet to 8,900 feet. This gives an excellent series for studying variation. This work is being conducted in the laboratory at the University. A series of about 1,300 butterflies has been taken, most of which have been expanded. Many moths have also been secured. Large collections of Odonata have been secured, and as soon as the eastern part of the state is more fully covered this group of insects will be taken up, a treatise on those in the western part being now in manuscript. The botanical collections number thousands of specimens, and when the work of identification and labelling is completed the University will have a very creditable collection of the plants of the state. The collection embraces specimens from varying altitudes up to 10,000 feet, and from localities heretofore unexplored. Included among these is a large series of lichens.

A large collection of entomostraca has been made, during the several seasons, and from many bodies of water. A portion of the material has been worked over and the remainder is now being examined.

The accompanying illustrations were all taken by members of the station staff or those attending the station. Due credit is given for each. Some of the cuts have appeared elsewhere, for which acknowledgement has been made in the proper place.

The bulletin will place on permanent record much information which is important, and which in a few years would be lost or very difficult to secure.

Bulletin No. 1 of this series, "Summer Birds of Flathead Lake," by P. M. Silloway, is out of print; the large edition having been exhausted a short time after its publication.

The author takes this public manner of expressing his high appreciation of the very cordial support given by those who have accompanied him on collecting trips and assisted in the work at the Station at Flathead lake. The recollection of smoldering campfires in many wild places, with sleeping bags containing tired but happy naturalists, working

without compensation for the sake of knowing, is a fond memory. It is on such occasions that enduring friendships are formed, the ties of brotherly love firmly bound, and the great and unknown field in a new country opened to view. The cheerful and happy dispositions manifested on trying occasions, when rain, or snow, or hunger, or fatigue was most severe, are characteristic of that great body of men who care neither for labor nor fatigue if there is added something to the sum total of human knowledge.

It is a pleasure to note that much of the work represented by this publication has been accomplished through funds contributed by friends. To the many who have aided in the work by contributions sincere thanks are tendered. We are under special obligation to Senator Wm. A. Clark, who has rendered great service by generous contributions on many occasions.

THE AUTHOR.

University of Montana, Missoula, Montana, September 14, 1902.

Establishment of the University of Montana Biological Station.

The organization of the University of Montana Biological Station was effected in the spring of 1899. The State of Montana contains several lakes of larger size, and many smaller ones. Very little work has been done on any of these lakes, that of Forbes on Flathead and Swan, as given later, being all that is known. Little systematic study of birds, flowers, insects, shells, or kindred topics, has been made save the collections from expeditions which have been taken to the institutions of the east for study. While there have been many expeditions to Montana and the Northwest Territory, and while large quantities of material have been taken from the state and incorporated in reports, there nevertheless has been little systematic study of particular groups by residents of the state.

Early in the spring of 1899 a trip was made to Flathead lake for the purpose of selecting a site for the station which would meet the demands for work. Through the kindness of Mr. E. L. Sliter the launch "Undine" was placed at the disposal of the writer, and almost the entire shore of the lake was examined.

The site chosen is on the main road to Kalispell, which is 18 miles distant by wagon road, and nearly double that by water. The steamboat running between Kalispell and the foot of the lake will stop to let off and take on passengers. The launch "Undine," the property of the Kalispell Club, is also moored here. It is a pleasure resort of considerable prominence. The hotel at Bigfork gives accommodations to those who do not wish to live in tents. The mouth of the river makes an excellent harbor for small boats, which is a very important item on so peculiar a body of water as Flathead lake, where the waves may rise high in a few minutes.

A small field laboratory was erected on the banks of Swan river, a short distance from the lake. A few rods from the laboratory a bridge gives communication with the opposite side of the river. Immediately above the bridge a series of rapids offers excellent sport for the fisherman, as well as exceptional field for the photographer. The country in the immediate neighborhood is well timbered. To the north the country is well tilled, fine fields of grain and good orchards making a splendid showing in the fertile valley. Two and a half miles to the west the Flathead river enters the lake, its mouth being marked by a well defined delta with sand banks and shoals, a great shelter for birds during the migratory season.

The laboratory is a wooden structure with suitable accommodations for summer outdoor work. There is table room for twelve students. The site is excellent for camping. A large spring enters the river from the bank immediately below the laboratory.

A mile and a half from the laboratory along the road south is Daphnia pond, covering some fifteen or twenty acres. A description of this pond is given later. About the same distance farther is Estey's pond, covering a little less space, but fully as interesting. It is eight miles by the nearest road to Swan lake. This lake is the expansion of Swan river, and lies in the glaciated valley between the Swan and Mission ranges. The lake is about 12 miles long, perhaps a half mile to a mile wide. A few miles to the northeast is Echo lake. Near it is Rost lake. Along the banks of Flathead lake on either side may be found numerous ponds and small lakes; others are reported to be in existence, but have not yet been studied or examined. The northern part of the state is well dotted with lakes which await study.

The Lewis and Clarke Forest Reserve extends to within a few miles of the station, and offers exceptional opportunities to study forest influences and subjects relating to forestry.

A few miles eastward and the Swan range of the Kootenais is reached. This range has several peaks nearly 10,000 feet in height, with dozens of alpine lakes, rock ridges, snow slopes, and other collecting places. The Mission range is immediately south of the station, ending as a range at Swan river. The range makes the eastern bank of Flathead lake, is well timbered, and rises higher toward the southern end, where the peaks reach nearly 10,000 feet.

The preliminary work of the Station naturally falls within the country immediately near the laboratory, and in the Mission mountains and the Mission valley. This territory lies between Missoula, where the University is located, and the laboratory. In the fall of 1897 a collecting trip of three weeks was taken to the Flathead Reservation. This was the first collecting expedition from the University, and resulted in a large supply of material in various lines.

In 1899, during the month of August, the first work of the Station was begun. During this month considerable time was spent on the lake, making soundings and gathering microscopic forms from the water. These are incorporated in a paper presented to the American Microscopical Society.

In 1900 two months were devoted to the work of the Station. The month of July was spent in the Mission mountains and in the Mission valley gathering material, the month of August being spent at the Station.

In 1901 a party outfitted at Missoula, and started for the field June 13, continuing the work of collecting and studying either in the field or at the laboratory until August 21, when the party returned to Missoula.

The party consisted of Dr. D. T. MacDougal, of the New York Botanical Garden, making collections in botany; Wilson P. Harris, of Brooklyn, N. Y., collecting lichens; Maurice Ricker, Burlington, Iowa, High School, collecting entomostraca; P. M. Silloway, Fergus County, Mont., High School, studying birds, and the writer.

Collections were made in the Mission mountains. Several peaks were ascended, and McDonald and Sinyaleamin lakes, which had been visited the previous year, were again visited for comparison of records. The party moved slowly up the east side of Flathead Lake, making occasional excursions into the Mission range.

After reaching the station and depositing a large proportion of the luggage a trip was taken to the foot of the Swan Range eastward. Rost lake and Echo lake were partially studied. Several excursions were made into the range, with packs on backs, and many peaks ascended.

In August, Dr. H. C. Cowles, from the University of Chicago, with a party of nineteen students, spent ten days at the laboratory. The entire party, with many others, made the ascent of the Swan range in safety, returning laden with specimens. More detailed information relative to these mountains and their lakes is given later.

During the summers of 1900 and 1901, Prin. P. M. Silloway, of the Fergus County High School, spent the months of June, July, and August in the study of the birds. The nesting birds near the laboratory were made a special study, and a good series of nests and eggs secured, notwithstanding the weather was very bad most of the time. The results of the work are embodied in the bulletin from the Station (21). He also made extensive studies of the birds in the Mission range and in the Mission valley on the west of the range. During this time a large series of skins was secured, now deposited in the museum of the University, and a large amount of data collected relative to the birds of the state. This gave excellent opportunity for studying those birds which make the state their summer residence. As a matter of fact there were less than a half dozen birds noted which apparently came from the north on their autumnal migration.

L. A. Youtz, of Columbia, devoted two months of the summer of 1900 exclusively to the study of the entomostraca of the lakes and rivers in the western part of the state, so far as the travels during the summer permitted. His observations extend to the waters of Sinyaleamin lake, McDonald lake, the ponds and creeks in the Mission valley, Flathead lake from one end to the other, Flathead river, Swan river, Daphnia and Estey's ponds, and to this was added the material from Swan lake after he left the party.

During the following summer the work was continued by the writer, assisted by Maurice Ricker, of the Burlington, Iowa, High School. The same lakes and rivers were visited, as also Echo lake, Rost lake, Silloway lake, Placid lake, Trail lake, and other smaller bodies and streams of water.

In 1902 work at the Station was continued during July and August. Mr. Harry N. Whitford, with a party of botanists from the University of Chicago, carried on studies in forestry. Large collections of plants were made, forestry conditions carefully considered, and a large series of photographic negatives made. Prin. P. M. Silloway spent the month of June at Swan lake, and July at the Station. He secured much information additional to that given in his bulletin "Summer Birds of Flathead Lake," which will be incorporated in a supplementary report. The work of collecting entomostraca from the lake was continued by Mr. Maurice Ricker, of Burlington, Iowa, and the writer.

Special Studies.

Among the other groups special study was made on shells and dragonflies. Shells in the State of Montana are relatively scarce. Few reports have been made on shells taken from this region. The only list so far available is the one given in *Nautilus*, Vol. VIII, p. 63, giving a list of 42 species from the Missouri river. The material from the western side of the range lists 21 species. The conditions in the State of Montana are not favorable to the growth of shells. The rivers are rapid, with scarcity of food, and with little lime. The lakes contain clear cold water, are usually deep, with few swampy places, and with rocky shores and bottoms. The marshy stagnant portions of the lakes are usually small, and liable to dry up in summer. The mountain sides in summer become dry and parched, except in protected portions and along streams. Great stretches of plain are without moisture for a portion of the year, and almost every living thing that cannot move to the water courses is killed. The days in summer are hot, the nights cool. The air is dry and evaporation is rapid. As a result of the above conditions we may expect great variation of species in adjacent regions, where the barriers may be sufficient to cut off all communication between the regions. It is hoped by making extensive collections of land and fresh water shells to secure sufficient material to throw some light on the geology of the region, which now offers many difficult and complex questions. One new species has been discovered, and the first living specimens secured. Another has been found at an altitude of 9,000 feet. In the report of the work on the lakes following information is given regarding the limited number of species found in each.

The work on Odonata has been prosecuted with more or less vigor during the past four years, besides material taken at different portions previous to that time. The result is the discovery of about fifty species in the state, which is not a large showing. The same conditions making it difficult for shells to grow in the waters of the state will apply to dragonflies. The young live in water, which must not be swift nor too clear, but must offer sufficient animal food to keep the larvae alive, must be stagnant enough to support life of such slow and uncouth water dwellers and must offer them suitable hiding places to keep out of the sight and reach of enemies. Such places are not common. In Illinois the writer was accustomed to visiting the ponds around town, taking as many as 25 species in a single afternoon. In Montana a hard and long day's work has resulted in but six species, and not many specimens of these. From this it will be seen that dragonfly collecting in the state is not only difficult, and the results meager in amount of material, but from what has been said there is a possibility of securing many new and interesting things.

During the three seasons of collecting in the western part of the state large numbers of botanical specimens have been secured, which are deposited in the herbarium of the University, and await study.

It will now be helpful to the reader to give some information concerning the region under discussion, which will convey a better idea of the country than has heretofore been given.

The Mission Mountains.

The Mission range is familiar to all old-timers of the State of Montana. Its snow-clad peaks appear suddenly before the eye as the traveler reaches the crest of the hill above Selish, the railroad station on the Northern Pacific where the traveler leaves the train and takes the stage for the mountains, Flathead lake, or Kalispell. The first view is one of grand comparisons, with the broad and beautiful valley in the foreground, the majestic peaks of the Mission range behind, while in the direction opposite rise the rugged Cabinets, the abrupt and pointed Squaw peak being the most conspicuous.

No one can see the Mission range without bursting into exclamations of surprise and admiration. A view is given in Plate XIX. The high, snow-capped, jagged peaks, rising abruptly from the valley, usually shadowed by clouds whose lower strata obscure the higher peaks, offer such decided contrast to the level valley that the comparison is very noticeable.

The range is about 75 miles long, the higher peaks being on the southern end. The range slopes gradually down to a lower altitude northward, finally ending as a range at the Swan or Bigfork river.

Very few of the peaks in the range have received names, though most of them are large enough and of sufficient importance to be named. McDonald peak is the only one with a name recognized as belonging to a definite height. McLeod peak is a well established peak on the southern end of the range, and has been one of the points used in triangulation by the United States Geological Survey for many years. McLeod peak is south of the Jocko river. Big peak is another name given to one of the heights opposite the peninsula at Flathead lake. But the particular height to which the name is applicable is not definitely established. Aside from these three, and a fourth on the map a little north of McDonald and called Teton, none of the peaks in the range have names. Since the work in this region was undertaken the necessity for naming many of the peaks, lakes, and points of interest has become apparent, and some suggestions have been made.

Mention was made of the fact that the Mission range was cut in twain by the Jocko river. Immediately north of the river is a high point, very conspicuous, and without a name. The name suggested for this is Sinyaleamin, an Indian name meaning "surrounded." Years ago the Flathead and Blackfeet Indians had a fight on the banks of the creek having its source in this mountain, with the result that the Blackfeet were surrounded and exterminated. The Indians made reference to this in naming the creek "Sinyaleamin," afterwards changed to Mission. As the mountain mentioned had up to this time no name the name Sinyaleamin has been given to it. Plate XX gives a view of this mountain. It is also seen on the right in Plate XIX. East of Sinyaleamin, and ap-

patently a part of the same range, are the well known Jocko peaks, shown in the illustration from the mountain summit, Plate XXI.

The range extends almost due north and south, the meridian 37 passing along the western base of the range. The 46th and 47 parallel degrees approximately mark the southern and northern ends, though a large bend extends toward the east in the southern end of the range.

The drainage from the western side is across the Flathead Reservation, through several creeks, into the Pend d'Oreille river, and into Clarke's Fork of the Columbia. The drainage from the eastern side is into the Swan river, north around the range into Flathead lake, and out through the Pend d'Oreille river as before. From the southern end the waters are carried by the Jocko river into the Pend d'Oreille river. A portion of the eastern slope of Sinyaleamin mountain, as also the eastern slopes of the Jocko peaks, drains into the Clearwater river, thence into the Big Blackfoot; from this into the Missoula, and finally into Clarke's Fork of the Columbia. It is thus seen that the entire drainage of the range is into the same stream, though by very different routes, and over distances of varying lengths.

SINYALEAMIN LAKE.

The first place in the range at which work of consequence was undertaken was at Sinyaleamin lake. See plates XXII and XXIII. As has been stated, this little alpine lake is at the southern base of Sinyaleamin mountain. From the nature of the location of the lake the name is very appropriate. Locally the lake is called St. Mary lake. As there is another larger and more widely known St. Mary lake in the northern part of the state in the Blackfeet reservation, the name Sinyaleamin lake is most appropriate for this beautiful little sheet of water, and should be retained.

St. Ignatius is about six miles from Selish, on the Northern Pacific railroad. From St. Ignatius to Sinyaleamin lake the distance is given as nine miles. The distance to the mouth of the canyon is nearly six miles and the road up the winding canyon is about three miles. The road across the valley is excellent. A mountain road has been constructed up the canyon to the lake. This is passable in summer, is no doubt good in winter, and with a little work could be made very good indeed, save for a couple of steep hills. The road follows up the canyon carrying the waters from Sinyaleamin lake. This stream joins the main stream before it reaches the Mission. The waters from the branch stream are derived almost wholly from Sinyaleamin lake. The waters from the main stream of the Mission creek come from the mountain peaks to the north of Sinyaleamin mountain, tumbling over a high fall which may be seen miles away on the plain.

The lake is hemmed in on all sides by mountains, only a small flat near the water affording a camping site. This camping site is on the top of an old moraine which is well covered with small timber. If the timber was cleared away there would be a good-sized camping site in an admirable location for scenery. Campers are continually widening the small space by cutting down small trees for fuel and it is now a delightful place for a camp for either outing or study.

Our camp at this lake was from July 7 to July 18, 1900. The party numbered 15 most of the time, and for a couple of days there were 23, including a number of distinguished visitors. The weather was perfect, not a thing to stop work for the entire time.

A second visit was made in June, 1901, a month earlier than in the preceding year. A large collection of plants was made and further notes and collections of shells were taken. Dredgings were made for Entomostraca in the lake and in the ponds to the south of the lake. As the season was early there was much moisture. This made the material collections more abundant but made the work more laborious.

On the north side of the lake the mountain rises abruptly to a height recorded by our aneroid as 9,200 feet, probably 200 in excess of the true height. On the summit abundance of snow could be seen. The lower slopes are moderately wooded with small red fir, while the upper heights are bare jagged rocks. On these a few white-bark pine have a foothold. See Plate XXIV. On the east and south of the lake the summits are lower, sloping gradually to the south and then to the west where the ridge descends almost to the level of the waters of the lake. The mountain sides in this direction are densely wooded with small trees. The western end of the lake is the only part with what might be termed open country. Here the lake is dammed by a moraine which is now covered with small trees and other vegetation. This moraine extends across the ravine, which is here about a quarter of a mile in width, and down stream for nearly a mile, as nearly as could be determined. The present outlet is at the southern end of the moraine. There are indications that the outlet was formerly at the other end of the moraine, next the mountain side proper. From indications it would appear that the lake was formerly larger than at present, when the waters were dammed up, overflowing what is now the good camping place, and for some distance beyond. On the moraine the vegetation is different from that at other places, indicating that the period when the waters covered this part of the moraine is not so very far back in time. The time that has elapsed since the outbreak at the present outlet has not been great. When the lake occupied this addition it was larger, and perhaps forty or fifty feet deeper. When the water first started at the present outlet the cutting was rapid, as shown by the abrupt and narrow declivity at the outlet, and resulted in the present lake level.

By damming up the present outlet the level of the lake could be raised about fifty feet without overflowing the moraine.

The lake is about 7,500 feet long and 2,500 feet wide. The shape and outline are readily seen from the accompanying sketch. See Fig 1. The length lies east and west. The lake is clear, cold, and deep. At 8 P.M., July 9, 1900, the temperature was 15 degrees Centigrade. By trials it was found that the white net used for collecting entomostraca could just be seen at a depth of 30 feet. The dark rocks on the bottom could be seen only at much less depth than this.

The banks of the lake are precipitous, no shoals or rocks being found. The largest shallow place is on the western end of the southern side where a small shallow place some 300 feet long by 50 feet wide slopes

Sin-yale-a-mir

Cedar Forest

Lake



FIG. 1.

Diagram showing shape of Sinyaleamin Lake.

down from shore. At the upper end, around the inlet, there has been some filling, but it has been slow. The depth a few hundred feet from the inlet was 30 feet, but it shot down rapidly to 115 feet, and finally to 250 feet, the deepest recorded. This depth was taken opposite the rocky cliff toward the upper end, but a glance at the map of the lake will show it is everywhere deep. But a few feet off shore near camp at the southern end the depth taken was 165 feet.

There is but one inlet, at the upper end, draining the eastern slopes of Sinyaleamin mountain and the Jocko peaks where there is abundance of snow the year through. There are no small inlets save when the snow is melting off the hills in the spring, but there must be a little underground seepage, as there is considerable water on the mountain sides high up that disappears before the stream reaches the lake.

The stream forming the inlet comes through a canyon from the north, Sinyaleamin mountain forming the western wall, one of the Jocko peaks the eastern. Along this creek for a quarter of a mile or so there is a rank growth of beautiful arbor-vitae trees, as shown in the illustration. See Plate XXV. These continue until the canyon becomes so narrow there is room only for the stream, which tumbles over a cascade several hundred feet high, a portion of which is shown in Plate XXVI. This cascade was followed for some distance and as far as could be seen or heard the cascade continued. Later, from the summit of the mountain, the direction and source of the stream was determined.

On account of the land locked position of the lake it is seldom disturbed by storms, although some strong gusts blow in from the west. The surface is usually calm and smooth, timber growing to the water's edge, making a beautiful reflection. It appeared from indications along the shore that the surface of the water in the lake varied some three or four feet, at the time of our visit being at its lowest. There is very little drift in the lake. At the outlet there is quite a pile of old logs that have come down, but they show evidences of long submergence in the water, and are not in great quantity considering the timber around the lake. The shores are free from drift.

Three ridges lead up from the base to the summit of the mountain, all of comparatively easy ascent. The ascent of the mountain from the lake, whose altitude is 3,800 feet, was made in a day, returning very late at night. We almost failed making it though within sight and hearing of the camp. This summit is really a long ridge, extending southeast and northwest, culminating in two peaks, and joined to the remainder of the range to the north by a low spur at the easternmost of the two peaks. On the north the drainage is into the main branch of Mission creek. The western peak drains into the stream below Sinyaleamin lake. The drainage from the country to the eastward and southward, as shown in the illustration, see Plate XXIII, is into Sinyaleamin lake.

On the 12th of July, 1900, the ascent of Sinyaleamin mountain was made. The start was made before seven in the morning, three of us preparing our loads for the ascent. The outfit consisted of a camera with 15 plates loaded, a rifle, a shotgun, a botany can, provisions for a day, and

necessary ammunition and material for saving specimens. Although it was the middle of July the morning was quite cool. By keeping behind the hill on the western ridge of the three we were in shadow for a good portion of the distance. It was not until nearly at the limit of trees that the sun's rays began to be felt. The ascent to the timber line was devoid of interest, save that at about 7,000 feet a mother bird with a brood of chicks about three days old was flushed among the *Xerophyllum* through which the ascent led. This grouse, known as Richardson's grouse, seems to be common to this range of mountains, and was taken on several different occasions. It was a surprise to find the chicks so young. This proves either that the bird had misfortune the first sitting and made a second nest, or that the altitude retarded the nesting time. The size of the birds discovered and their ability to escape at the age of a few days may easily be conjectured. Two of these little fellows were captured by hand, and proved to be the only birds secured on the trip.

Lunch was eaten at 7,800 feet, and the summit looked near, but the ridge looked steep and rocky. We were ascending a "hog back," a ridge leading to the summit. It was narrow, in places no more than wide enough to travel in single file, occasionally widening with small grassy plots, in which flowers were growing in great profusion. On the summit of the ridge, and occasionally in the crevices on the sides, a few white-bark pines had a foothold. See Plate XXIV. Their trunks were gnarled and twisted, with broken limbs and stunted branches, showing plainly the great struggle they were enduring. The dead trees are light and dry, burning with a great amount of smoke and much pitch, blackening everything used about the fire for cooking to an unusual degree. The picture given shows plainly the condition of the trees.

Insects are always scarce in high altitudes and flowers are always brilliant. The slopes of Sinyaleamin mountain were no exception. The zoologist may find some food for reflection in this. If insects have been instrumental in developing color in flowers, as is concluded from modern theories, this condition is to be expected. The few insects seen were very busy, and had a wide field to work over and an abundance of flowers to select from.

Luncheon over, and a supply of typical flowers having been gathered and a few insects taken, the ascent was resumed.

Mountain climbing to some people is a pleasure, to others a drudgery. Certain it is that few people enjoy climbing up among the timber and over slippery grass, with nothing to see but the limbs of trees immediately ahead, the grass or rocks under foot, and occasionally a patch of blue sky or a glimpse of a peak or a canyon. But when one finally ascends to the rocks, where grass does not grow, where trees are few and stunted, and where solid rocks are piled in stratified layers or tumbled in confusion as the case may be, mountain climbing becomes to most people a pleasure and a reality. When one can rest on solid rock for a moment and before him see the peak in all its grandeur, to the right a mass of snow with a stream of silver leading away, to the left a wall of rock 3,000 feet high, it is worth the effort needed to get to the position.

The interesting part of this climb was that one of the party was being

initiated, never having climbed before to such a height or been in such a trying place. The result was interesting both to himself and the others. The sight was too much, and his nerves refused to stay under control. All his will power was not sufficient to hold his muscles in control, and he shook as with a palsy. Places that could be passed with a step were trying and difficult, and often required minutes to get over. He reported it seemed as though all the rocks were loose and ready to tumble down, and to see him pick and try at rocks to see if they were stable was under most circumstances really amusing. Under present conditions it was trying. Needless to say the rocks were solid. It is sufficient to say that in such attempts either all reach the summit together, or all return together without reaching it. The higher we ascended on the peak the sharper the ridge became, and the steeper, and with this there was greater trepidation on the part of the shaking member of our party. Constant encouragement was necessary, and repeated lifts and boosts were given. Although a man of mature years and of careful habits, ordinarily calm and deliberate, he reached a point where he had no confidence in himself, and even refused to stand erect on places that were perfectly safe and with abundant room. All this was the result of the effect of the crags, cliffs, waterfalls, and peaks on such an immense scale that it was too much for the nervous makeup to stand, and there was a collapse. When the collapse came it was quite complete, and lasted until the foot of the mountain and camp were reached. Needless to say the result was to make the individual exceedingly weary. Long before the others were tired he was almost overcome, though this was most noticeable after the last cliff and crag were out of sight behind.

The last thousand feet of rocks were almost completely bare. But at the altitude of about 8,500 feet, as indicated by the aneroid, we came across a small shell among the rocks, on the summit of the ridge. This little shell belongs to the *Pyramidula*, and is known as *P. strigosa* var. *alpina*, and was found in considerable abundance. While the others went on the conchologist devoted a quarter of an hour to the search, resulting in securing some two or three dozen and several live ones. No doubt many could have been found if search had been made, as they were picked up occasionally almost to the summit. There was very little vegetation on which these shells could live, an occasional plant with a few leaves and a stunted stem being seen here and there on the rocks. Aside from this there was nothing to decay. The trees had long since been left behind and there was nothing else alive visible, save the lichens.

These shells reveal a very interesting point in adaptation. A near relative has been found on the high mountains in various portions of the State of Montana. *Pyramidula strigosa* Gld., small variety, has been taken on the sides of nearly all the high mountains in the western part of the state. They have been collected at an altitude of from 8,000 to 9,000 feet in the Tobacco Root mountains in the eastern part of the state. *Pyramidula strigosa* Gld., var. *cooperi* W. G. B., is found along the shores of the lakes and along the damp banks of the streams. Apparently some of the lower forms have ascended, becoming accustomed to altitudes above

the lakes and rivers, and being able to live on the mountain sides during the damp spring months, in summer disappearing from sight until the following spring. As the ascent was made and the struggle became fiercer the size of the shells became reduced, this form being much smaller than the variety *cooperi*. But still others ascended to higher realms and are now found on the highest and bleakest of rocky slopes. This *P. strigosa* var. *alpina* is no doubt the result of this gradual ascent. In size it is small, being really diminutive. The struggle is great. Food is scarce. To support so large a body as the small form lower down, or the ordinary specimen at the lake or creek, is impossible. Consequently, there has been a change in structure to accommodate the changed conditions, and the shell is much reduced in size. The form, *cooperi*, has not been found by the writer above 4,000 feet. The small variety is found from 5,000 feet to 7,000 feet in the west, and higher in the east. The diminutive variety has been taken on this occasion at an altitude of 8,500 feet and from that nearly to the top. The same diminutive shell was later taken on McDonald peak at an altitude of 8,000 feet to 9,000 feet.

Plate XXVII will give the reader a better idea of the size and relationships of the shells before mentioned than can be obtained from a description.

The summit was reached at 4:15 in the afternoon. It was completely bare of vegetation save for one little straggling specimen on the western edge, catching the rays of the sun, and not sufficiently far along in growth to make a determination. The aneroid registered 9,150 feet. Although the sky was cloudless a few pellets of snow came from some place and struck us in the face. At our feet was an immense snow drift on which the camera was planted and which was covered with goat tracks.

The sight was fine. No one can tell the glories, beauties, or depict the awfulness of the view from one of the heights of the Mission range. To the west is the twin peak of the one we have ascended, showing beautifully the stratification, and the formation of the mountain. Beyond this peak the mountain drops almost abruptly to the plain. To the north the range appears as one vast jumble of peaks and ridges, though of course there is order in it all. Reference is made to the impression. To the east the Jocko peaks rise abruptly from the snow fields, old snags that appear incapable of being ascended. A view of these is given in Plate XXI. Between Sinyaleamin and the Jocko peaks is a large glaciated region, no doubt the former ice region supplying the material for the moraine at Sinyaleamin lake, or the lakes toward the east. At the foot of the old Jocko crag is a small lake, filled with slush snow and ice, as viewed from our distance, and which has been christened Snow lake in consequence. This Snow lake is in the drainage of Sinyaleamin lake, the waters entering Snow lake, overflowing, passing down over the rapids into Sinyaleamin lake, and on to Mission creek. To the south Mount Lo Lo, in the Bitter Root range, may be seen 75 miles away. The Bitter Root range, Cabinet and Swan ranges, the Mission range in the foreground, the Kootenais and the Rockies, make a grand and beautiful panorama. Thirty miles to the north may be seen Flathead lake, blue as the

sky above. The Mission range shows up grandly. It is a magnificent sight.

The descent was made along the ridge to the southeast, so as to descend the middle ridge of the mountain instead of the western one. The descent was begun at 5:35, and was devoid of interest save that the trip was exceedingly difficult and tiresome. In an evil moment a ravine was selected, which was followed for some time. In one respect this was fortunate, as late in the evening a movement was seen in the bushes ahead indicating a bear. The head man immediately dropped to his knees. A black patch about the size of a man's hand was all that could be seen, and instantly it was fired at. The surprise of the mountain climbers was great to behold a monster porcupine roll over into the ravine. He was big and heavy, and it was nearly 4,000 feet of a descent to camp, and already getting dusk, owing to the fact that we were in the ravine. Tying his legs together the beast was slung across the back of one of the men, and the descent in earnest began. This was the largest porcupine ever seen in the region. Indeed, porcupines in this section of the state are scarce, and many an old timer has no recollection of ever having seen one. When 2,500 above camp a scheme was resorted to in an effort to arouse the camp which is worthy of mention, as it may be used by any one in any locality. The idea belongs to Prin. Silloway, though it may be commonly known. Taking a double-barrelled gun, opening the breech, and blowing in the breech end as in a conch shell a noise is made that is deep, heavy, and resonant, and may be heard a long distance. The noise made on this occasion was clearly heard in camp a half mile below, and much farther by the road we had to travel. Also, we could hear their reply, though told afterwards that all had called together at the top of their voices in order to make us hear. This blowing on the gun barrel is the cheapest whistle a hunter can buy, and will carry the sound farther than any on the market. Late that night, about ten o'clock, the party arrived, tired and hungry, as is usual in the mountains, but well paid for the trip.

ORNITHOLOGY AT SINYALEAMIN LAKE.

Animal life around the lake is interesting, but not abundant. The ornithologists followed the birds from daylight until dark, which is most of the time when the days are so long. The nesting season had apparently closed, and not a single set of eggs was taken or seen.

While the list of birds seen at this lake includes 39 species which is a fair number, there was no abundance of any species. Owing to the character of the banks traveling was difficult. The waters of the lake harbored little food, and aquatic life was relatively scarce. In the dense arbor-vitae woods at the head of the lake the carol of the winter wren was frequently heard, while in the cascade the American dipper boldly dashed back and forth in the spray. A pair of wandering loons once rested over night on the lake. The American golden eye now and then made appearance on the lake. Along the shores the spotted sandpiper was not uncommon. In the woods Richardson's grouse and ruffed grouse were frequently flushed. A desert sparrow hawk, pursued by pine siskins, was seen when high up on the mountain. The belted kingfisher

was common around the shores of the lake, and in the woods might be seen woodpeckers of several species. Cabanis's woodpecker was not uncommon, Batchelder's woodpecker was occasionally seen and heard, one pair of red-naped sapsuckers was seen for a day, the lordly pileated woodpecker made announcement of his presence by his loud call and hard and slow pounding on the trees, while the red-shafted flicker was seen and heard daily. At dusk the western night hawk occasionally was seen in the air, while during the day, strange as it may seem, an occasional humming bird was seeking food from the various flowers about the lake. The sharp and far-away sounding call of the western wood pewee was frequently heard on the hillside. Wright's flycatcher was common in the timber south of the lake. The black-headed jay was not uncommon, and a single curious Rocky Mountain jay was one day seen lurking around camp. Higher up on the mountain, above 4,700 feet, Clarke's nutcracker was found. In the woods adjacent to the lake the American crossbill was common, and pine siskins were frequently noted in the air overhead or occasionally were seen in camp having come for crumbs. Everywhere on the reservation where observations were made the western chipping sparrow was found. Around the lake Shufeldt's junco is abundant. Black-headed grosbeaks were not seen about the lake, but at the ponds a mile to the south they were abundant. The brilliant Louisiana tanager was everywhere to be seen, while the handsome cedar waxwing was frequently noticed at the pond with the grosbeaks. The red-eyed vireo, warbling vireo, Audubon's warbler, Townsend's warbler, and Macgillivray's warbler were the insect feeders noted in the trees. The Rocky Mountain creeper was only occasionally seen, though the slender-billed nuthatch is common. Every walk brought to view the long-tailed chickadee. The notes of the olive-backed thrush were regular features of the woods. A single pair of western robins were feeding the young on the nest during the stay at the lake.

The region seems to be a place of resort for birds, where they come for a time and disappear, as is the case with the region as far as man is concerned. Later investigations may reveal more.

CONCHOLOGY OF SINYALEAMIN LAKE.

One would expect to find an abundance of shells in and around such a body of water as this lake. In this, as in many other points, there is disappointment. These clear cold lakes do not offer a large supply of food for such dainty feeders as shells and the supply is not abundant. The small alpine form, *Pyramidula strigosa*, var. *alpina*, has been previously referred to as having been found near the summit of the mountain. In the woods along the borders of the lake the larger *Pyramidula strigosa* Gld., var. *cooperi* W. G. B., was taken rather abundantly. With the preceding *P. solitaria* was found in less abundance. Only a few *Polygyra townsendiana* Lea, var. *ptychophora* A. D. Br., were taken. These two have so far been found together, the former most abundantly, the latter much less so. These four land species were all that could be found. In the water three more species were taken, all sparingly. *Physa heterostropha* Say was not abundant, but several large and very fine specimens were taken. Now and then *Planorbis trivolis* was seen.

Nearly an entire afternoon was spent at the outlet attempting to secure a few of these two species, and the result was not very flattering. An Illinois bog would produce a thousand for one. The most noticeable snail, and the most difficult to secure, was *Limnaea emarginata*, a small variety. The same species was found very abundantly in McDonald lake fifteen miles further to the north, and is also in Swan lake across the range east. In Sinyaleamin lake the shells are for the most part singly on stones in the bottom where the water is shallow, or along the bank. They are very light in color and very conspicuous. To secure them it is necessary to take a boat, row slowly where the water is shallow, and when one can be seen wait until the water becomes smooth and either pick it off by hand if not too deep, or by some other method. As there is much trouble to determine the depth of the water on such occasions the task becomes quite difficult, and the result is often a wetting. Our best success was to take an insect net, and with this gently pull the shell off the rock by inserting the net under the snail, thus letting the animal fall into the net. Even this is slow work. The snails have the peculiar habit of letting all holds go when anything touches them, falling to the bottom among the pebbles, where it is very difficult to see them. An entire afternoon was spent fishing for these specimens, a couple of dozen being the number secured, and many getting away. It is readily seen from this that a small bottle may hold the entire catch of an afternoon. Notwithstanding the difficulties, the snails present many interesting points, and are well worth the effort. No bivalves were seen anywhere.

By comparing these notes with the record of McDonald lake it will be seen that the snail life of the two regions is very similar.

The butterflies noticed were not numerous. Those seen were *Colias eurytheme*, *Basilarchia lorquina*, *Vanessa milberti*, and a species of *Lycæna*. These latter were collected in small places where the butterflies seemed as close together as they could get, as many as 75 or 100 being collected in one small space. No effort was made to make a collection of moths or butterflies, attention being diverted in other directions, but on account of the cold water and the limited vegetation it is not likely the best place to seek such insects in quantity.

ENTOMOSTRACA.

Dredgings and surface catches were made during each day of the ten spent at the lake. Altogether 39 vials were filled, each representing a catch. Usually the catch represented fifty strokes of the pump. It was our custom to take a surface pumping, then attach ten or fifteen feet of hose, afterwards 25 feet, then 50 or 75, then 100, afterwards all that could be put together, 140 feet. It was soon discovered that during the day very few entomostraca were at or near the surface, though they were always to be found late at night or early in the morning near the surface. To seek a solution of the problem pumpings were made late at night, before daylight in the morning, and during the day. It was observed that light was not suited to these animals, and that as soon as day dawned they sank to a depth of 25 or 50 feet, remaining until dusk, when they again returned. These observations were verified later in McDonald lake, in Flathead lake, and Swan lake. It was found that to

secure specimens in day time the hose must go to a depth of 25 or 30 feet, while at night they were as numerous at the surface as any place else. These diurnal movements are very interesting. It does not appear that the movements are in schools, but that the movements are everywhere uniform.

These observations are not in accord with those made on Flathead lake on July 6. At that time *Cyclops pulchellus* Koch was exceedingly abundant on the surface of Flathead lake, in great numbers, on a bright sunshiny day.

Observations showed that life at night was most abundant at the surface, the quantity decreasing toward the bottom, until at the lowest point reached by the apparatus, 140 feet, but few forms and relatively few of each species, were found. Life in the lake is scanty as compared with that in the shallow ponds near the lake, and small ponds found at other places. Yet considering that the water is so clear and cold and contains so little food the life appears abundant.

The most abundant species, which had practically entire control of the lake was what appears to be a new species of *Diaptomus*. The next was *Daphnia thorata* Forbes, a species allied to *Daphnia hyalina* Leydig. *Cyclops Americana* Marsh was rather abundant. No amphipod crustacea were observed in any place.

The work in this lake was made possible only by the use of a canvas boat which was secured on purpose for the work, and which served its purpose admirably. See Plate XXVIII. This boat was 14 feet long, and carried about 800 pounds as the largest load given it, carrying this in perfect safety. The only boat on the lake was an Indian scow found near the upper end on the shore, which the boys towed to camp and fixed up so as to be serviceable, but which was very unwieldy and could not be used to any advantage. It was jocularly termed the Oregon, but was not used to any extent, and would never have been found save with the canvas boat. The canvas boat, *Daphnia*, was used constantly to transport the collectors to different parts of the field at the lake, and to go across and from end to end. It was in use most of the time by some one, was light and easy to handle, and was a general favorite. The boat was a source of much examination on the part of the Indian visitors both here and at other portions of the reservation. They seemed to think it was good for any kind of a trip, and an invitation was extended later to take a badly wounded Indian with a well friend a distance of 20 miles on Flathead lake, and the same distance returning. Needless to say the offer was not accepted. It was with much hesitancy a canvas boat was taken, fearing it would be unserviceable, but it was a complete success. In a short time after landing at the lake the boat was in use and was readily packed up when camp was broken.

By following the canyon leading south toward the Jocko for a distance of two miles there are to be found several ponds. The first one is small, and at the time of our observations contained little water, though much life in proportion. In fact the first pond was not much more than a puddle. This was in the canyon before it had widened much. But a little farther the canyon widens considerably, making a pond cover-

ing several acres, and still further widens into a beautiful park with fine timber of yellow pine and tamarack, with a pond much larger than the preceding. How many more may be beyond is not known. Reference has been made to these ponds under the remarks on ornithology. They proved to be very interesting from the entomostracan standpoint.

As the boat was not taken to these lakes the hauls were made by throwing the net out from shore with a long line and pulling it in. It was difficult to secure a haul more than thirty or forty feet from shore. On one occasion the pump was taken and pumpings made.

The entomostraca differ radically from those found in Sinyaleamin lake, some two miles distant. The species identified are *Diaptomus leptopus* Forbes, *Cyclops serratus* Fisher, *Moindaphina*, probably *alabamensis*, and *Cyclops signatus*. Not a single one of these species was found in Sinyaleamin lake, and not a single species found in the lake was taken in these ponds. As the ponds are shallow and the water warmer, besides having different food conditions, it is probable there would be a difference in the two lakes, but no such striking difference was expected. From a casual observance the idea was gained that the lake possibly had an outlet through this canyon, but the life in these ponds does not confirm the idea, but opposes it.

One surprising thing at these ponds was the scarcity of dragonflies. It would appear that this would be an admirable place for these insects to breed in, yet very few were seen. From this it will be inferred that the ponds freeze to the bottom in winter, thus killing the most of the larvae, but this is only conjecture. It is also possible that the numbers of birds in the region may keep them pretty well killed off. At any rate, they were scarce. *Aeschna constricta*, *Sympetrum obtrusum*, and *Enallagma calverti* were the only species observed. Not an *Ischnura* was seen.

The presence or absence of fish in these ponds was not determined, but all the evidence was negative. The ponds gave the impression from appearances that they would go dry in some seasons. If so the absence of fish would be accounted for, as also the absence of much other life one would expect to find.

One of the conspicuous features at the lake from a botanical standpoint was the abundance and beauty of the lichens. This is noticed in many places in the state, and in some places even more conspicuously than here. The lichens cover the trees in many places. Several species were taken in great abundance at camp. In breaking off dead limbs for firewood the choice specimens covering the small limbs were saved, thus procuring in abundance some fine specimens. At the upper end of the lake a beautiful species of *Lycopodium* was discovered, with long green trailing vinelike stem, several yards in length. In the woods a species of mushroom belonging to the *Polypori* was found growing quite luxuriantly, but mushrooms appeared very scarce.

From Sinyaleamin lake camp was moved to McDonald lake, fifteen miles north, in the Mission range. But the distance necessarily traversed to reach the latter lake is much more than the distance by crow's flight.

MCDONALD LAKE IN THE MISSION RANGE.

The road to McDonald lake from St. Ignatius Mission is good. The distance is about 11 miles. Most of the distance is across the level valley, the last two miles being a very stiff up grade, causing a hard pull when there is a load.

Camping sites at the lake are scarce, owing to the nature of the lake. There is but one portion of the lake, the western end, free from cliffs or rocks. Most of this is densely wooded with timber and heavy underbrush. By fording the outlet, possible in summer when the water is low, a camping site sufficient for the party was found, on the bank of the lake, in plain view of the peak, free from underbrush, and above all, in a place where the cool breeze from the mountains after sundown drove away the mosquitoes, which are much of an annoyance in the region in early summer. The camping site was a delightful place, and a stay of ten days in 1900 was made in order to make collections, and search for living species of the shell *Pyramidula elrodi* Pils., as well as to study the entomostraca of the lake. A camp of a week in June, 1901, was made for the same general purposes. Plate XXIX gives a good view of the lake from the outlet.

McDonald lake of the Mission mountains lies at the foot of McDonald peak on the northwest. Like Sinyaleamin lake, it is hemmed in on all sides except the west by mountains, save that they are much higher, more picturesque, and steeper. The lake was named McDonald back in the sixties, and according to priority the name should easily displace that given to Terry lake, also called McDonald, which lies northeast of Kalispell.

The valley enclosed by the peaks, in which the lake now is, has been carved out by a glacier, or more properly by glaciers, as there were undoubtedly several uniting to form the main glacier which flowed down the valley. Remnants of these glaciers are yet seen on the mountains, there being three on McDonald peak, one in plain sight from almost any point on the lake. The rocks along the lake have been ground smooth, and show plainly the marks of the ice. At the outlet of the canyon a large moraine has been made, though not so advantageously situated for damming the water as at Sinyaleamin lake. But the water has in time past evidently been much deeper than it now is. The rock on the north is fast disintegrating, and is filling up the lake with red mud and ooze. At the upper end is a wooded valley which formerly must have been a part of the lake. The filling in has drained this part of the lake, the remainder of the lake not yet being filled up. The present lake is therefore but a part of what it was formerly.

The lake is smaller than Sinyaleamin lake and not nearly so deep. It is a mile to a mile and a quarter long, the average width being less than a quarter of a mile. On either side the mountains come abruptly to the water, as may be seen in the illustration given, Plate XXIX. As has been stated, there is a valley at the upper end, so far unexplored, and densely wooded with arbor-vitae, several species of fir, white and red birch, and other smaller shrubs. The inlet divides above the lake, one branch receiving water from the glacier visible, the other bringing

the water from the amphitheater toward the east, which has for drainage not only the peaks visible, but also the eastern slopes of McDonald peak. A general view of the upper end is shown in Plate XXX.

The bottom of the lake is comparatively level and from the mud on the bottom the impression is gained that the lake is either older than Sinyaleamin or has filled up much faster. The depth from end to end is nearly uniform, the deepest being eighty-four feet. The lower end is shallow, the outlet being crossed by a ford, hub deep in July. There is considerable shallow water. The mud at the bottom is of a reddish color, apparently from the decomposition of the rock on the north shore. At a point near the middle a ledge of rocks projects from either side, making the lake at this point quite narrow. The ledge is precipitous, and the water a few feet from the rocks is deep. These stones are worn smooth by glaciation, and show deep and numerous glacial scratches.

On the north, to the left in the illustration, Plate XXIX, the rocks are very steep for about 2,000 feet. Shale and cliffs alternate. By much hard work one can reach the top of the talus. Above is a mass of precipitous rock, not to be ascended from this side. Four waterfalls, with small streams, tumble over the rocks. The waters disappears in the loose talus at the base long before it reaches the lake. The southern slope is not so abrupt. Large masses of loose talus, with large boulders, line the water's edge, making a loose and spongy surface for the retention of moisture.

Life in and around the lake is not abundant. There are few frogs, and probably no snakes, as but one of the former was seen during the ten days and none of the latter. On the rocks at the water's edge, altitude 3,300 feet, several pika, *Lagomys princeps*, were killed. This is the lowest altitude known to the writer at which these peculiar animals have been taken. They are abundant on the peak at 8,000 feet and over, but none were taken, owing to the difficulties in getting them when killed among the crags at these high altitudes. The banks of the lake are so steep and rough that it is all but impossible to climb along. Almost an entire afternoon was spent in going the length of the lake a few hundred feet from the water's edge. An exploration will probably show great possibility of increasing the size of the lake by overflowing the valley at the upper end, if it shall ever become a necessity to use this lake as a reservoir site.

On the northern side the timber is not so dense, owing to the nature of the rocks. The banks are steep, and the cliffs afford poor hold for the roots of trees which have not gained much headway. On the mountain above the precipitous rocks the timber is quite heavy, being largely of yellow pine and fir. The southern bank is well wooded. The canyon at the head of the lake is densely wooded, through which there does not appear to be an entrance made by road or trail. At the outlet and along the moraine near the lake there is fine timber, some of which has been cut for rails and lumber. Everywhere there is much underbrush, making progress difficult.

The road to the lake is good, considering it is a mountain road. There is some travel over it. The lake is a great resort for the Indians and those who visit the reservation, on account of the excellent

fishing and beautiful scenery. There is no drift around the shores, most of the drift having lodged in the outlet. Here there is a quite a jam.

CONCHOLOGY OF McDONALD LAKE.

Search was made daily for shells. In the waters there were large numbers of a new variety of *Limnaea emarginata* Say, described in *Nautilus*, Vol. XV,* as var. *montana*. This is the same shell that was previously taken in Sinyaleamin lake with so much labor, and was much more abundant in McDonald like than in Sinyaleamin. Along the rocks in the middle of the lake they were taken in considerable numbers, and at the outlet others were taken among the grass and weeds in the shallow water. This species seems to relate *emarginata* to *stagnalis*, some of the shells showing the malleations of *stagnalis* quite plainly. Placed side by side they have many points in common, but are very much smaller than the variety *appressa* of *stagnalis* taken in western Montana.

Physa ampullacea Gld. was found sparingly, not so abundant as in Sinyaleamin lake. Strange to say, not a single specimen of *Planorbis* was seen. *Planorbis* seems to be a warm water species, and while a few were taken at Sinyaleamin lake, they were very scarce, and the few taken were small and badly broken. In the small ponds and lakes in the valley to the west of the Mission range *Planorbis trivolvis* is exceedingly abundant, and in the small lakes or ponds of glacial origin along Flathead lake these shells are found in great numbers.

Among the underbrush at the lower end of the lake *Pyramidula strigosa* var. *Cooperi* was found in large numbers, as also *P. solitaria* Say. These two species have been considered distinct heretofore. A large series of several hundred was assorted with the attempt to make two species. The most widely different were easily separated, but by this process of elimination those remaining were more and more difficult to place in one species or the other, and the last remaining could apparently go as easily in one pile as the other. From external appearances it seems difficult to distinguish some of those found at this lake as belonging to either the one or the other species. The two were found in the same locality, were picked up together, and were placed in the same receptacle. It was impossible to do anything toward working out life histories, and internal anatomy may reveal differences that external anatomy does not disclose. But as descriptions of shells are largely based on external anatomy it is doubtful if these two species are distinct. It may be well to note here that all the shells taken so far at the upper end of Flathead lake are var. *cooperi*, none having been taken that could be called *solitaria*.

Having found a very small variety of the shell *Pyramidula strigosa*, called *alpina*, at high altitude on Sinyaleamin mountain, it was thought the same shell might be found on the heights of McDonald peak. A short description of the trip in search for this shell is given in the succeeding pages. Sinyaleamin mountain is almost due south of McDonald peak, in the same range, the distance between the two peaks in air line being

* *Nautilus*, Vol. XV., p. 111.

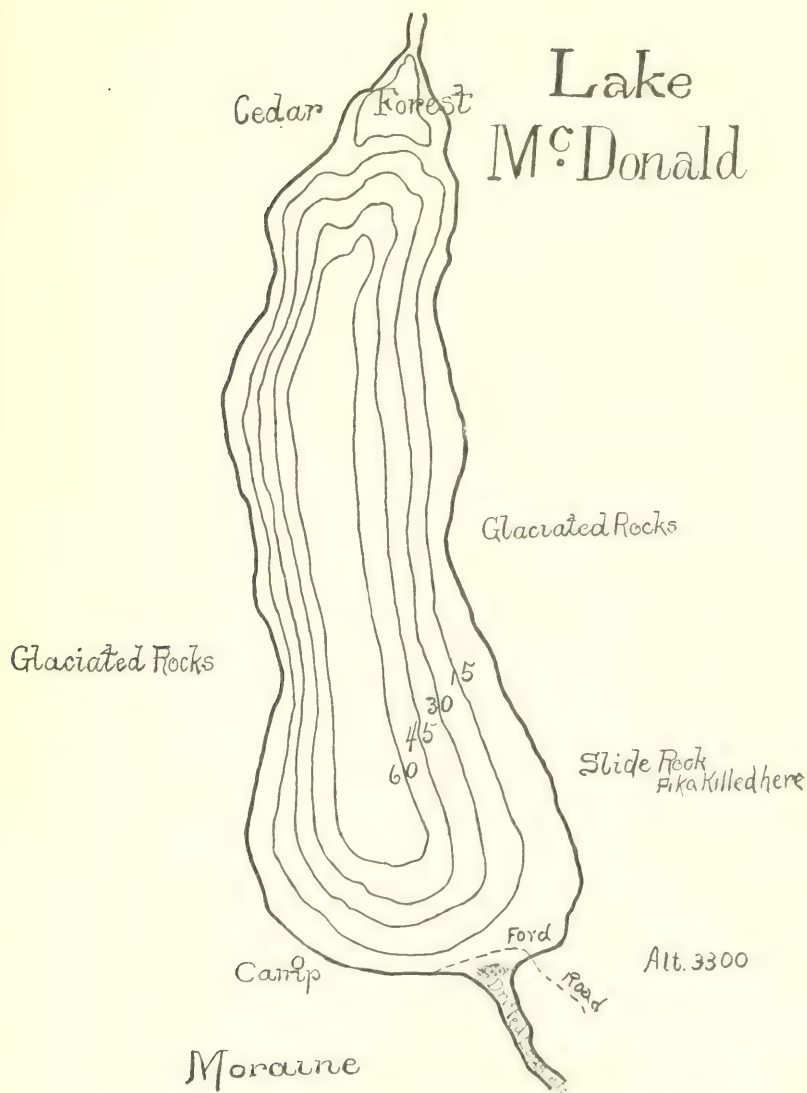


Fig. 2. Diagram of McDonald Lake, showing contour, depth and shore characteristics.

something like twelve or fifteen miles. On the assumption that the shells would start from the water course, and possibly follow the ridge on the shady and damp side, they must have taken entirely different routes in ascending the two peaks. They were found abundantly on McDonald peak at the altitude 7,800 feet to about 8,500 feet. It is worthy of note that the shells seem to begin and end rather abruptly. When first found, on either mountain, they were found in considerable numbers. The high summits of McDonald are so steep, and the broken rocks so large in size, that there seems a limit to the range of the shell on McDonald. From our observations it appears that on the south side of Lake McDonald there is a break from the slopes immediately above the lake, with altitude about 3,400 feet, to 7,800 feet, in which no *strigosa* have been found. They are probably there, but sparingly, since diligent search was made during the ascent. On the other bank, however, the northern slope, *strigosa* has been taken from the lake to altitude 7,500 feet, and continuously. Moreover, the shells taken at the high altitude on the north slope are many times the size of those taken on the opposite mountain. The locality in which the shells were taken on McDonald is on a ridge facing the west, bare of trees and other shelter, wind-swept, and storm-swept. On the north, on Teton mountain, the ridge faces the west, but is well wooded and protected, and apparently retains moisture much longer. To conchologists and others the wanderings of this shell will be of much interest, and the description has been given in some detail because of that interest.

A good series of *Polygyra townsendiana*, var. *ptycophora* was secured. The underbrush was so dense that it was necessary to crawl on hands and knees most of the time among the shrubs and small trees. By digging in dead logs, overturning decayed stumps and branches and pulling apart dead leaves a good series was obtained, but at the sacrifice of clothing and flesh.

Of these three species many were found eaten by squirrels. These were carefully preserved, and examination made of the method of procedure. The usual method was to break the shell at the apex of the spire, making a good sized opening. Through this the animal was drawn and no doubt afterwards devoured. A few openings were made at other places, and sometimes at very unfavorable places, due no doubt to lack of experience on the part of the enemy. Of the species *P. strigosa*, var. *cooperi* fifty were found thus broken into. Of *P. solitaria* four or five more than of *cooperi*, while *P. townsendiana*, var. *ptycophora* had but two thus eaten. As these latter much more resemble the surroundings than do the striped *Pyramidulas* this is not surprising, and is a good illustration of protection.

On the talus north of the lake the bleached remains of a hitherto new shell were lying abundantly on the rocks. During the short stay at the lake in July, 1899, some forty specimens of this shell were secured, Pillsbury described it as a new species in *Nautilus*, Vol. XIV., P. 40. The species is shown in Plate XXXII. It certainly is a species as distinct as many other described species, and certainly is unlike any other shell so far described in many respects. Whether or not intermediate

forms will be found which will destroy the identity of the species is to be determined. During our stay of ten days at McDonald lake several days were spent almost entirely in searching for both living and dead specimens. More minute descriptions of the results of this search have been given elsewhere, and need not here be repeated. It is sufficient to say the living shells were found. The first were taken high up, on a small space on the top of a crag where there was a little decaying rock, while trying to get a good position for a photograph of the peak opposite. The success on this occasion spurred to greater effort, resulting in finding other living shells nearer the water's edge, by going deep among the talus toward moisture. But none living were found among the rocks close to the lake. The net results of this search were several quarts of shells, with several dozen preserved animals, some of them beautifully expanded.

This shell, *Pyramidula elrodi* Pils., appears to have a very limited range. It is found abundantly on the northern shores of the lake westward to the last stream of water trickling over the rocks, when it ceases abruptly. On the southern shore of the lake it is found very sparingly, but a few being found as the result of an afternoon's search, among them a single live one. There is good reason for believing they occur along the slopes of the mountains that form the amphitheater above the lake, bordering the valley mentioned, as otherwise their presence on the south side of the lake is not accounted for. They have been found up on the side of the mountain as far as explorations have been made, up to 7,500 feet, and still seem to continue. How far up the mountain they are to be found is problematic, and should be determined. Diligent search has so far not revealed the species at any other part of the Mission range. It is expected later to make collections on the east side of the range, when search will be made for the shell there. Search for shells during succeeding years has failed to produce a single specimen from other localities than the one here described. The distribution therefore seems to be extremely limited. The amphitheater may better understood by consulting Plate XXIX.

The shell is not only a land form, but is a rock form. It seems to have a preference for nooks and crevices on the summit of some cliff. In searching for them it was discovered they were most abundant along the water courses, where vegetation had not yet gained a foothold. It was unnecessary to search among the debris collected at the roots of a clump of bushes, but if there was an open space where the talus was loose and open they were likely to be found. In the spring time they evidently crawl over the brown lichen covered rocks in search of the lichen food, crawling beneath when the warm days come on and the moisture on the rocks dries up. The few remaining too long are killed, their shells bleaching from a dark flesh brown to a beautiful pearly white. It is described by an admiring friend as the queen of the *Pyramidulas*. By digging among the damp talus a few live ones may be found. Higher up, where there are small springs from the mountain side, they may also be found.

During the season of 1901 a week was spent again at McDonald lake

in the last of June. It was the rainy season. In three weeks there were but three or four days of sunshine. While this bad weather was hard on those living out, as we were obliged to do, it was the best time of the year for collecting. One day while at this lake the rain came down almost the entire day. It was just such a day as would be good for land shell collecting, and rigged out in gum boots and a slicker the writer spent the greater part of the day crawling through the wet underbrush in search of shells. They were found in great abundance. *P. strigosa* and *P. solitaria* were out in great numbers. It is no exaggerations to say that if one had desired to do so he could have secured a peck of these two species. With them was now and then found a *Polygyra townsendiana*, var. *ptycophora*, but they were in no great abundance. Considering the small territory examined the number of shells to be had of these two species in the region of McDonald lake is very great. As it is the collection taken and brought to the University of Montana was more than a thousand specimens from this field alone.

The camp was made primarily to secure further information relative to *P. elrodi* Pils. Immediately after a rain the rock talus on the north bank of the lake was examined. The rocks were very slippery, the grade steep, and the bushes dripping with moisture. Rain fell a portion of the time. But *P. elrodi* was at home. Large and small, they were everywhere in abundance. In 1899 but a few bleached shells were found on the exposed rocks. In 1900 a much larger number of bleached shells was found, together with a few live ones. They were also followed up the mountain slope about two thousand feet. But during the camp of 1901 large numbers, of all sizes and apparently all ages, were taken. They were crawling over the rocks in plain sight, though almost invisible save by close scrutiny, owing to their resemblance in color to the rocks, and were traced up the mountain to an altitude of over 7,500 feet. At this altitude the dead shells with occasional live ones, were still abundant. As we had started up the mountain in the afternoon it was impossible to go farther that day, and the return was made to camp, with plans for ascent to the end of the shell region. That night a storm prevailed, and we concluded from indications we would fare better out of the hills, and got out, none too soon. The next morning the hills were white with new snow, remaining so for a long time.

In making this search up the mountain a shell was found which is undoubtedly a hybrid between *P. elrodi* and *P. solitaria* or *P. strigosa*. It has the form and sculpturing of the former, and the characteristic band markings of one or the other of the latter. Which of the latter it is difficult to determine. But as *strigosa* was much more abundant along the ridge than *solitaria* the hybrid is probably *elrodi* and *strigosa*. The shell is of a young specimen, less than half grown.

P. elrodi is not the only shell that made the ascent of the mountain. Associated with it, even to the highest point, *P. strigosa*, and *P. solitaria*, in varying numbers, were taken. The result, is a fine series, from altitudes from 3,300 feet to 7,500, which will afford material for working out the results of altitude.

It is not inappropriate to quote the following paragraph in reference to *P. elrodi* and its home.

"It is a shell of the rocks. It lives among the crags of the Mission mountains, where there is scant vegetation, preferring the crannies at the top of some cliff, where large colonies have been found. Among the loose rocks it finds a home, hides from its enemies, thrives during the springtime when snows are melting, and, later, when the rocks are dry and hot, crawls beneath where there is a little moisture, throws a transparent film across the opening of the shell to prevent evaporation, and awaits the coming of the next season. Those animals which have not sought the damp and cool crevices early enough are prostrated by the heat. They soon die, and their bleached and empty shells may later be found by the collector who is so fortunate as to be in their locality. They do not like the bushes. It was found unnecessary to search the rocks about clumps of bushes, for none were there. But on exposed places, where the rocks were bare and clean, dead shells were found, and by digging below an occasional live one was secured. I envy this shell its home. It is one of the most beautiful spots of the beautiful Mission range. The grand old peak, McDonald, is constantly in view, its rocky crest most of the time covered with snow. Below, smooth and placid, McDonald lake invites attention. To the west a little water fall tumbles over a rocky cliff, and the water disappears in the loose talus below. Anon an eagle circles in the heavens, and the American raven casts a silent shadow as the bird passes over. The wild laugh of the loon rings in the air at midnight, and mountain goats browse on the vegetation above. Clouds gather at the summit of the peak, and fierce lightning on a moonless night illumines the sky with vivid and lurid light. The thunder-peals roll from crag to crag, and with deafening crash startle every living thing. Again the day is clear and the sun is bright, sunshine such as only a mountain region can give, and all is quiet, serene, and beautiful. Perhaps for countless years these varied scenes have been enacted. The home of this beautiful shell is as beautiful as the shell itself, and the carving and sculpturing which have been given by Nature as an adornment to the shell are but a miniature of the immense ridges and ravines everywhere abounding."

The shell life of McDonald lake is therefore seen to be very interesting. While there is no large list of species, those to be found are in good numbers, and the collection of shells made at this camp was very satisfactory.

ORNITHOLOGY OF McDONALD LAKE.

Bird life at McDonald lake is similar to that at Sinyaleamin lake, as was to be expected. The rugged condition of the country prevented extensive collecting. The woods and brush at the outlet of the lake were the most prolific places examined, and notwithstanding the dense brush and the attending difficulties, were the only places where much collecting was done. A two days' trip to the summit of the peak brought in several specimens, but the bare ridge ascended was comparatively free from bird life above the forest belt, and below that most of the time was employed in hunting a way for ascent. Around the lake the effort to take birds was exceedingly laborious. The ornithologists made strenuous efforts to search the shores of the lake, but it was almost impossible

to get around. More collecting was done at camp than at any other place. Once Prin. Silloway shot a Townsend's solitaire, a very interesting catch. It fell five hundred feet down a cliff, entailing a half hour's work to find it and recover the ground lost. Unidentified raptors circled above him in perfect disregard of futile efforts to secure them, as he describes in his report.

As usual at our camping places, the spotted sandpiper, *Actitis macularia* L., was common along the shores of the lake. On the slopes toward McDonald and elsewhere on the hills Richardson's grouse, *Dendagapus obscurus richardsoni* Dougl., was not infrequent. Franklin's grouse, the fool hen of popular reputation, was common in the vicinity, *Dendragapus franklini* Dougl. The gray ruffed grouse or pheasant, *Bonasa umbellus umbelloides* Dougl., was common in the thickets along the water courses. The sharp-shinned hawk, *Accipiter velox* Wils., was found regularly near the lake. *Accipiter cooperi* Bonap., Cooper's hawk, was common along the cliffs of the lake, but were on such inaccessible pinnacles that they could not be taken. The western red-tail, *Buteo borealis calurus* Cass., the American rough-legged hawk, *Archibuteo lagopus sancti-johannis* Gmel., and the desert sparrow hawk, *Falco sparverius deserticolus* Mearns, were all seen about the lake. The only owl observed was the western horned owl, *Bubo virginianus subarcticus* Hoy, which is common in all the woodlands of the region. Its mournful note was not infrequently heard in the evening or at night.

A single pair of kingfishers, *Ceryle alcyon* Linn., seemed to have charge of the lake, and worked industriously at the inlet at the upper end of the lake, where the diverging streams from the main source made the fishing excellent.

Five woodpeckers in all were taken at McDonald lake. One specimen of the alpine woodpecker, *Picoides americanus dorsalis* Baird, was taken near camp. The rednaped sapsucker, *Sphyrapicus varius nuchalis* Baird, is a common resident near the lake. The pileated woodpecker, *Ceophloeus pileatus* Linn., was heard several times near camp, and notwithstanding much shooting two were taken almost from the tent door. This large and beautiful bird is reputed to be shy of man. It has been taken throughout the Mission range, and nowhere does it appear as shy as is reputed. Lewis's woodpecker is common in the valley below the lake, and in the tall pines is one of the most common and conspicuous birds. Every where the red-shafted flicker, *Colaptes cafer* Gmel., is common.

Occasionally at nightfall the western night-hawk, *Chordeiles virginianus henryi* Cass., was seen flying about. The rufous hummingbird, *Selasphorus rufus* Gmel., was a frequent visitor to the flowers near camp, and was a delightful bird to see. Along the rocky wall of the mountain the calliope hummingbird was several times observed, without doubt, among the flowers growing along the small water courses dashing over the side of the mountain.

The western wood pewee, *Contopus richardsonii* Swains., and Traill's flycatcher, *Empidonax trailii* Aud., were the insect catching birds other than warblers taken at this camp.

The American magpie, *Pica pica hudsonica* Sab., the black-headed jay, *Cyanocitta stelleri annectens* Baird, and the American raven, *Corvus*

corax sinuatus Wagl., were all seen around the lake, though in no great numbers. The raven was often noted, and repeated efforts were made to secure specimens, but without success. The only method of approach was by the canvas boat, and by this means the ornithologist was always visible. To enter the timber and get among the rocks was to get out of sight of the prey, and progress was almost impossible. The American crow and Clarke's nutcracker, *Nucifraga columbiana* Wils., were also seen around the lake, the former sparingly, the latter common at elevation of 7,500 feet and above.

The fringillidae, while not numerous in species, were abundant around camp at all times. Most abundant among the seed eating birds was the pine siskin, *Spinus pinus* Wils., which was everywhere about camp, usually high overhead in the tallest trees. The western chipping sparrow was almost as abundant, *Spizella socialis arizonae* Coues. High up on the mountain, at an altitude of 7,500 feet or more, Shufeldt's junco, *Junco hiemalis shufeldti* Coale, was taken, the range extending from this altitude down to the lake, 3,300 feet. Among the bushes along the mountain sides the call of the spurred towhee *Pipilo maculatus megalonyx* Baird, was heard, and several were added to the collection. The Black-headed grosbeak, *Habia melanocephala* Swains., the lazuli bunting, *Passerina amoena* Say, and the Louisiana tanager *Piranga ludoviciana* Wils., were frequently seen and specimens were added to the list.

On the eastern side of the lake a colony of cliff swallows, *Petrochelidon lunifrons* Say, had made their habitations in the rocks. The song of the red eyed vireo, *Vireo olivaceus* Linn., was frequently heard and the bird was not uncommon. In common with the warbling vireo *Vireo gilvus* Vieill. was heard, and now and then a specimen was added to the collection. Audubon's warbler, *Dendroica auduboni* Towns., was common in the woods, the most abundant of birds, perhaps, while not infrequently Macgillivray's warbler, *Geothlypis macgillivrayi* Aud., was noted.

In the rapids above the lake, and in the waters adjacent, might be seen the American dipper, *Cinclus mexicanus* Swain. The delightful carol of the winter wren, *Troglodytes hiemalis* Vieill., was often heard at the upper end of the lake, but so secretive was the bird that it was but seldom a sight of it was obtained, and then but a passing glimpse as the bird flitted to a new location, to again begin its song. The Rocky mountain creeper, *Certhia familiaris montana* Ridgw., was noted almost daily. Also the slender-billed nuthatch, *Sitta carolinensis aculeata* Cass., and the long-tailed chickadee, *Parus atricapillus septentrionalis* Harris, were seen.

A single young Townsend's solitaire, *Myadestes townsendii* Aud., was captured, and the adult was seen. These were the only specimens of this species seen on the trip. It seems to be very rare to the region.

The thrushes include the Olive-backed thrush, *Turdus ustulatus swainsonii* Cab., which was common, the western robin, *Merula migratoria propinqua* Ridgw., also common, and the mountain blubird, taken at altitude of 7,500 feet, but seen at the lake.

The bird life of the lake as here given proves very interesting. The camp of ten days produced forty-seven species, all of this being the re-

sult of the work of Prin, P. M. Silloway, who devoted his entire time to the study of the ornithological fauna, the results being given in detail elsewhere.

ASCENT OF McDONALD PEAK.

A party of six made the ascent of McDonald peak, taking two days for the trip, with the intention of gathering material from high altitudes. The start was made early in the morning, going as far that day as could be gone with a horse, which was taken to carry provisions, material, and blankets. The ascent for the greater portion of the distance from camp was through dense timber, where it was impossible to see out. The first steep slope, however, was open timber, full of ripe huckleberries, and where there was considerable evidence of bear. Soon, however, a dense growth of small yellow pines and fir, so thick a man could not enter them unencumbered, was encountered, barring the way. This small timber had been seen from below, and appeared to extend for a mile and a half or more, but from a distance the timber did not appear so dense as was found on closer inspection. It became necessary to either go around or return, and the former was decided upon; but even this was very difficult, owing to the growth right up to cliffs, making it difficult to get the horse through. After much toil and fatigue the ridge leading up to the main peak from the northwest was reached, when ascent became less difficult, and finally comparatively easy.

It is well to remark here that there is a well made trail to the highest point to which a horse may be taken, the trail leading up from a ridge near St. Ignatius, from which point many of the ascents are made. This trail was made in the early days, and over it many persons of note have travelled. By this trail it is possible to ride on horseback from St. Ignatius to snow. It is utterly impossible to take a horse to the summit. The nearest point to which a horse can be taken is about twelve hundred feet from the summit. The last twelve hundred feet require about four hours of hard climbing.

Camp for the night was made at an altitude of 7,800 feet, as shown by the aneroid. There was not much place for camp, the ridge being narrow, and the rocks rough. But by vigorous efforts each of the party hollowed out a place large enough to lie in. Rocks were piled up on the down hill side so as to prevent rolling over the cliff, which was but a few feet away. Rolled in a blanket, the night was spent here. The locality may be better understood by referring to Plate XXXIV.

The timber at this place shows the ravages of fire. The south side of the mountain in past years has been covered with a good growth of white-bark pine. These extended a little above our camping site, and for a long distance below. Fire had passed over the mountain in years gone by, killing the trees, but leaving them standing. The result may be seen by an examination of Plate XXXIV. At present the timber has not made a new start, and the ground is comparatively bare, and in the summer, from its southern exposure, becomes dry and parched. The opposite side of the mountain is a cliff on which nothing can grow.

At the time of our ascent a forest fire was raging below, filling the air with smoke, making it difficult to see in some directions, and materi-

ally interfering with the work we wished to do in photography. Over the range, in the Swan river country, another fire was raging. These fires were started by the Indians, if reports are true. A few days before as we were on our way to McDonald lake, the first signs of fire were seen by us when still miles away. It was remarked that the fire would reach alarming proportions if not attended to, and such was the case. It is difficult to care for fires started in this way, owing to the lack of transportation facilities, and also owing to the difficulty in getting help sufficient to extinguish them. The fire raged for several weeks, ascending the mountain higher and higher, until a fortunate rain extinguished it.

Immediately on making camp the work of collecting was begun. The botanist went energetically to work, and flowers were abundant wherever there was sufficient space and soil for a foothold. The rocks above camp were searched in the hope of finding more of the small shells, *Pyramidula strigosa* var. *montana*, which had been found for the first time on Sinyaleamin mountain ten days before. Sinyaleamin mountain could be plainly seen by us to the south, its snow covered peak being easily distinguished from the others. The shells had aroused so much interest among the party that all were interested in the search. Nor was there disappointment. A careful search of the rocks a few hundred feet above camp brought to light a couple of hundred specimens, among them several live ones. A careful search among the smaller stones, overturning them and examining the crevices, produced a collection that caused exclamations of delight from all.

McDonald peak is double, the western summit, the one ascended, being about a thousand feet lower than the eastern. The two are connected by a ridge, with a saddle or depression between them. To pass from the western summit to the eastern requires a descent of perhaps a thousand feet, then an ascent of perhaps two thousand. The western summit is easy of ascent, although the last 1,200 feet requires about four hours. But to ascend the main peak from the western summit seems difficult, though by taking the snow it is no doubt possible. Up to the present the main peak has not been ascended by the route from the west, with the exception of a rumor that the trip was formerly made by Indians. This statement has not been verified.

The main peak has three or four spurs projecting in different directions, behind or between which the snow lies in masses, glaciers apparently, remaining the year through. There is little snow on the western peak in summer, and its importance as a snow holder lies in the fact that it permits the snow blowing from the valley on the west to pile up between it and the main peak, thus making the glacier, visible from almost every part of the valley. These spurs make such protection that on three different places on the heights of this mountain the snow piles in drifts which never melt, making three large glaciers. One of these, the one seen from the lake, is shown in the illustration. The others lie behind the spurs. The waters from these three snow masses all flow into McDonald lake. The supply is therefore abundant and never failing. Moreover, the peaks to the north of McDonald peak, and which are also north of the lake, give much of their water to this lake.

The snow mass behind the spur to the left in Plate XXXV. flows into a small and beautiful lake, Leash lake. This lake is said by those who have seen it to be of surpassing beauty, usually full of snow, and visible only when almost upon it, so well is it hidden in the cliffs. The water entering the lake flows down the side of McDonald northward. After leaving Leash lake the water flows west, coming down and joining the stream from Teton on the north and the stream from the west glacier of McDonald.

Post creek, the outlet of McDonald lake, on the 30th of June, 1900, carried 473 second feet of water. The place at which the water was measured was some miles down creek from the lake, at a lower elevation than the lake by a thousand feet, and with considerable loss between place of measurement and lake through irrigation.

The Mission Valley.

This beautiful valley is bordered by the Mission mountains on the east, the Jocko river on the south, the Pend d'Oreille river on the west, Flathead lake on the north. The extreme length is about 35 miles, the extreme width about 15 miles. A terminal moraine separates the lake from the valley, bordering the lake on the southern end. The country immediately south of the moraine for a distance of ten miles is beautiful. It is level land, rich, capable of making good farms, easily irrigated. A large sand dune stretches across the valley about 15 miles from the lake, extending east and west. The eastern end is free sand, is not yet held in place by vegetation, and is slowly creeping eastward. The free and movable sand is 12 to 15 feet high, clean looking and white. Some eight or ten miles from this free sand westward one comes to the Pend d'Oreille river. The country abounds with depressions and coulees, with several large buttes from 100 to 200 feet high. It is in this region that the buffalo herd ranges.

The valley is crossed by four large creeks, as follows: Mission creek is the most southern. It takes its source in two canons, one the outlet of Sinyaleamin lake, the other Mission creek proper, with its high falls, visible for miles on the plain. Sinyaleamin lake receives its water from the eastern slopes of the mountains, principally from Snow lake, which is full of slush snow even in July. The stream leaving Snow lake tumbles over a beautiful cascade just before it enters the lake. The lake is described elsewhere. The stream from this lake joins Mission creek proper a short distance from St. Ignatius Mission. A third and smaller branch emerges from the canon between Mission canon and McDonald lake. This branch takes its rise in two small and beautiful alpine lakes, Twin lakes, lying high up in the mountains, fed by melting snows. Except in early spring this water is consumed in irrigation. Mission creek flows a little to the north of west, receiving Post creek a few miles west of the Mission, finally flowing into the Pend d'Oreille river. Mission creek may be located by examination of Plate XIX. Post creek is the outlet of McDonald lake, which receives most of its waters from the slopes of McDonald peak. The creek forming the inlet of the lake has two forks, one taking the waters from McDonald peak, the other from the peaks immediately to the north. This northern branch flows through two small lakes, and has some beautiful cascades, seen plainly from McDonald peak. Neither of these branches is known save for a very short distance from the lake. Post creek flows southwest into Mission creek as previously mentioned. Crow creek takes its rise in the mountains still farther to the north, in the canon through which runs the Crow creek trail. This trail is the Indian route across the range to the Swan river and Big Blackfoot river country. As it crosses the range at a high altitude it is passable only in summer, and is the only passageway between the Jocko river and the northern end of the Mission range. The creek flows a little south of west, receiving Mud creek near the sand dune previously mentioned, and flowing into the Pend d'Oreille river. It is a large creek,

clear of brush, a famous fishing resort. Mud creek rises in the canons near the southern arm of the lake, flows south of west, receives the waters from Roman Springs, passes the edge of the sand dune, and enters Crow creek a couple of miles from the dune. It is not a large creek, but irrigates several farms. A fair sized stream reaches Crow creek. From the sand dune to the lake is 15 miles. The land is level, and no streams cross it.

ORNITHOLOGY OF MISSION VALLEY.

The country between Crow creek and Post creek is full of pot holes, of varying sizes and depths, containing water all summer. Hundreds of these small ponds may be seen from elevation on the mountains, the larger ones lying near the mountains. These pot holes abound in entomostracan and insect life, prolific in quantity rather than species. Thousands of frogs line the banks all summer, and garter snakes, feeding on the frogs, are numerous, large and fat. In the grass and reed bordered ponds water fowls breed and rear their young. In the fall large numbers of migrant water birds stop at these ponds, making an ideal field for the hunter and sportsman. In July the most abundant water fowl found with young was the American Golden-Eye, *Glaucionetta clangula*, var. *Americana*, taken at several places. A camp of several days was made at Crow creek in July, 1900. Three years previously a camp of several days was made near the same place. In the creek three species of case worms were found. A quart of bivalve shells, *Margaritana margaritifera* were taken in the sandy shoals. Several other species of shells were found, *Planorbis trivolvis*, *Limnaea palustris*, a *Physa*, *Polygyra townsendiana*, var. *Ptycophora*, *Pyramidula solitaria*, and *P. strigosa*, var. *Cooperi*. Dragonflies were not numerous. *Aeschna conscripta* was seen everywhere. *Sympetrum obtrusa* was abundant; indeed, it is the most common dragonfly in western Montana, and is easily captured. Around one of the ponds near the creek *Sympetrum* (*Diplax*) *madida* was common. They were wary, shy, and hard to catch. Two hours of hard work resulted in only about two dozen. *Lestes unguiculata* was the most abundant. Hundreds could easily have been captured had they been wanted. A few *Amphiagrion saucium* and *Ischnura* were taken, making a total list of Odonata captured on the plain. In the stagnant water many Ostracoda were secured. Butterflies were not abundant. One catch of nearly a hundred *Brenthids* was very satisfactory. These were nearly always taken on a blue aster. *Colias eurytheme*, brilliant orange, were found in the grassy flats. *Pieris protodice* was not uncommon. A *Grapta* was occasionally seen. Among the shrubbery *Satyrus alope*, var. *olympus* was often seen. A single male *Argynnis leto* was captured. Several *Argynnis aphrodite* were among the captured. A single *Lycaena*, a few skippers, a *Thecla* and a *Chrysophanus*, made the remainder of the list. Except along the creek and around the ponds there is no collecting.

Birds in the valley are interesting, and around the water are abundant. The list of the ornithologist shows 43 species. Many of these are quite abundant. The few days spent here were fully occupied by the ornithologists, and over 60 skins was the result of their earnest work.

These were all prepared in rolled zinc holders to keep their shape until they could dry. In the few wheat fields several flocks of sharp-tailed grouse were flushed. Western meadow larks were everywhere abundant. A few mourning doves, *Zenaida macroura*, were found around the grain fields. Solitary sandpipers, *Totanus solitarius*, were along the streams. In the bushes catbirds, *Galeoscoptes carolinensis*, blackbirds, *Scolecophagus cyanocephalus*, yellow warblers, *Dendroica aestiva*, Audubon's warbler *D. auduboni*, flycatchers and others were always to be seen. In the trees were black-headed grosbeaks, *Habia melanocephala*, and woodpeckers, Lewis', *Melanerpes torquatus*, and Harris', *Dryobates villosus harrisi*. It was a pleasure to sit in camp and listen to the notes of the numerous species of birds. Over twenty were counted the first forenoon in camp, either by sight or by note. The total number seen during the few days at Crow creek is 43. Remembering that the creek forms but a narrow belt of vegetation in the valley, with dry plain and little vegetation on either side, this number is quite large.

GLACIAL ACTION.

Mission valley is undoubtedly glaciated. Between Crow creek and Post creek the valley contains many potholes, depressions in the surface which catch and hold water during the rainy season. At the lower end of the valley, near St. Ignatius Mission, large boulders lie high on the hills, while there are ridges and valleys plainly morainal. The valley and mountain range are worthy of careful study, and will repay the person who makes the study.

The southern end of Mission valley has a much larger moraine than that at the foot of Flathead lake, mentioned in succeeding pages. It extends from the mountains on the east westward as far as Plains on the Northern Pacific. It may extend farther as the writer has not been over the ground. The morainal matter in the vicinity of St. Ignatius makes hills several hundred feet high.* The height of these above this plain has not been determined, but it is certainly more than 500 feet. High up on these hills large boulders have been left stranded. The morainal matter here is badly broken and cut. The hills show plainly the presence of water in former times, beach marks being plainly visible from a long distance.

The entire Mission valley is made from glacial material, with high morainal deposit at both the northern and southern ends. The glacial drift extends many miles westward. It has not been followed, and the character of the soil cannot be given. The Pend d'Oreille river has cut a new channel through this valley, removing the glacial drift to bed rock. Whether this river drained the lake formerly covering Mission valley is for geologists to determine.

No doubt some of this material came from the Mission range. The mass of it could not have done so. The Mission range extends north and south. The canyons opening into the valley open westward. In front of each of the larger canyons is a small morainal dam, extending generally from north to south, or parallel with the range. The large moraines pre-

*It is possible the morainal deposit may be on a foothill, covering the rock.

vously mentioned extend from east to west, at right angles to the range. They are many miles in extent, much larger than any drift from canyons. A careful examination of the region north and west of Flathead lake will no doubt reveal glacial material on a large scale. From the trend of the mountain chains in that section of the state it will be interesting to trace this drift to its source. It is quite probable that this will be in the Kootenai mountains in the northern part of the state, with additions from the Swan and Mission ranges.

BOTANY OF MISSION VALLEY.

Collecting in the Mission valley is confined to the spring of the year. When the June rains fall almost dally the valley is a bed of flowers from end to end and from mountains on the east to mountains on the west. The vegetation is very characteristic. A few species of conspicuous flowers hold sway, and an examination of any spot after hours of walk will reveal almost identically the same flora over the entire distance. During the wet spring months the valley is a fairy land of flowers. But later when the rains cease the vegetation withers. The lupines are visible only by the stumps of stems. *Balsamorhiza sagittata*, with its big and thick leaves, is a conspicuous feature. The leaves dry on the stem, and stand so thick in places that to pass through makes noise enough to be heard a long distance. *Achillea* holds its green color well, but it succumbs to the heat, and withers on the ground. Wild Cranesbill is another abundant flower, and it with the others dies. The thousands of heads of cattle and horses nip the grass to the roots, and the former beautiful valley looks brown, bleak and bare.

The ride across Mission valley in early June, 1901, was delightful. Everything was at its best. Copious rains caused the vegetation to be profuse. While the number of species was not large the abundance of plants of a species was very great. Comment was frequently made on the beauty and abundance of the flora. Two months later the valley presented a brown, sun-scorched, and bleak appearance.

In 1902 the trip across the valley was made early in July. The vegetation was waning, but was still very beautiful. Most conspicuous were the large areas covered with *Clarkia*. *Clarkia pulchella*, Pursh. This beautiful flower will forever keep in memory of botanical students the name of its illustrious discoverer. The flower is a beautiful and delicate purple. The plant grows from six inches to two feet high, often spreading widely, though usually small, slender stalked, with a profusion of nodding flowers. It grows on the high and dry slopes, rarely appearing above 4,000 feet. It is a conspicuous feature of the landscape in western Montana during the summer. Often it is so abundant that the purple patches may be seen for miles. On the trip mentioned the *Clarkia* was just at its best. Everywhere in the valley it could be seen in greater or less abundance and profusion. Here was a beautiful stretch covering several acres, growing on a gentle southern slope. Yonder were smaller straggling patches, lending a delicacy of color to the mass of white *Achillea*, blue *Lupinus* and yellow *Balsamorhiza*. In whichever direction the eye was turned the *Clarkia* might instantly be distinguished from the other vegetation. In this open valley it is at its best. It is a flower

of the prairie or open hillside, rarely taken in woods, and then only in open places.

The western milfoil, *Achillea millefolium*, L., is also a conspicuous flower of the landscape. Everywhere in open prairies it grows in great abundance, although not in such great masses as the *Clarkia*. It is everywhere common, but grows among the other vegetation without apparently monopolizing the soil. In the Mission valley the milfoil thrives luxuriantly. In the early spring its clusters of dissected leaves lends a charm of color. Later the stem ascends, in midsummer reaching maturity. Its abundance of white composite flowers, scattered among the blue *Lupinus*, purple *Clarkia*, red *Geranium* and yellow *Balsamorhiza*, is easily recognized and is very conspicuous. Later, in August and September, the plant withers and dries on the stem; the leaves dry and become a dull brown; the flower stalks and flowers have fulfilled their mission, and the whole plant is dead and withered.

Another flower of the plain and open hillside is the composite *Balsamorhiza sagittata*, Nutt. This plant has large, thick, auriculated leaves, growing in clusters from thick rootstalks. The flower heads grow singly on branchless stalks a foot or two high. The plants do not grow tall. The large leaves spread out in every direction, casting shade over the smaller vegetation. Not only does the shade retard the growth of competitors, but the large rootstalks monopolize the soil. The flowerstalks are numerous, each with a large, yellow, and conspicuous head. The plant grows in masses. Its best season is in June. It begins to blossom in early May, continuing until late in July. In August the leaves wither on their stems, rattling more with the movement of an animal than dried corn stalks. *Balsamorhiza* grows abundantly on the dry and level plains. It is a xerophytic plant. It ascends the dry and open hillsides, and the large areas of yellow flowers may be detected miles away. Occasionally it seems to get into low and swampy meadows, where it struggles for an existence. It is sometimes seen in dense timber, often in open timber, but thrives best on open plain or hillside. It grows abundantly at all altitudes in the western part of the state up to 6,000, more sparingly for perhaps another thousand. In the Mission valley it has its best growth on the slopes nearer the mountains, and in the open woods and treeless hillsides. In the Mission range a species of *Lupinus* is as conspicuous as any of the flowers previously mentioned, and fully as abundant. Early in the spring its palmately compound leaves make their appearance, easily recognized. In May it has begun to bloom, the flowers continuing until late in July, when the last unfold. At the time of our passage, July 11, the plants had passed their best, save an occasional stalk which was covered with deep blue flowers, causing exclamations of pleasure and delight from the botanists of the party. Like the plants previously mentioned, this lupine thrives in the open plains or hillsides, but is almost as abundant on partially wooded slopes. Mountains from 2,000 to 3,000 feet high are in spring time clothed from foot to summit with its luxuriant growth, its deep blue making a charming mixture with the sombre green of the yellow pine, red fir, or the brighter green of the tamarack and balsam. Unlike the *Clarkia*,

and like *Achillea*, it is scattered everywhere, seldom occupying ground to the exclusion of other plants.

Here and there among the vegetation the traveler sees another composite, taller than the *Balsamorhiza*, with yellow center and dark brown ligulate border, much like the "bright-eyed Susan" of the east. This is *Rudbekia hirta*, a flower well worth cultivation for ornament. It is not so abundant as the others mentioned, but is strikingly conspicuous because of the decided contrast it makes with the remainder of the vegetation. Like the others it is xerophytic, selecting soil high and dry, lending a special charm by its beautiful flowers. Montana horticulturists should not forget it in selecting native flowers for ornament.

Less noticeable, but equally abundant along the way is a small composite resembling the eastern daisy or white weed. The flowers vary from a delicate pink to pure white. The plant is very abundant.

Less abundant than those before mentioned, but growing profusely wherever the soil is damp, along the edges of the glacial pot holes, on the banks of streams, around springs, in wet places on the mountain side or in the valley, the wild cranesbill, probably *Geranium caespitosum*, James, may always be found. Its general appearance and color are not so pronounced as those just discussed, but it is a well known plant, abundant, with luxuriant growth when it occurs.

Occasionally a thistle was to be seen, its flowers dull white or faint cream colored, its leaves presenting a bleached appearance, entirely unlike the delicate colors of the eastern pasture thistle. Its long and numerous spines give it good protection, and when it is seen the plant appears thrifty. But it is nowhere abundant. Here and there an occasional stem may be seen, but great patches of thistles such as are common in the middle and eastern states are unknown.

In the damp places along the road, of infrequent occurrence in the Mission valley, an occasional tall mallow, probably *Malvastrum numoanum* Gray, with delicate rose colored flowers crowding its upright stem, towers above the other foliage of the valley. These are stragglers. The plant thrives in the wet thickets and open banks of streams, where it is often very abundant. Flowers are often as conspicuous because of rare occurrence as of abundance. The traveler cannot fail to see the *Clarkia*. Its attention is forced because of its abundance. The same may be said of *Balsamorhiza*, *Lupinus* and *Rudbekia*. But in the Mission valley, where the vegetation is low, where the eye may see for miles, a tall stem covered with large delicate rose colored flowers is at once observed and noticed.

Wild dandelions thrive luxuriantly at places in the valley. Cinquefoil or five-finger is everywhere. Yellow composites with small heads show here and there. These, with the plants previously discussed, make up the greater portion of the vegetation over the valley. But the botanist who seeks the smaller and rarer forms will be able in a short time to fill his vasculum, each watered pot hole containing a large number which must be sought to be seen and which only the collector is likely to find.

About half way across the valley the traveller passes the sand dune

where free sand shifts from year to year, slowly moving eastward. On the sandy ridge but one plant has a foothold, i. e., *Symphoricarpus racemosus*, Michx., the snowberry. The sand buries this deeper and deeper each year, but it grows new shoots above, while the roots below are deep enough to obtain sufficient moisture.

In the early spring hundreds of small ponds in glacial potholes are filled with water. Around these collect various forms of animal life. Later these all dry up but a few of the larger ones, around which life is fairly abundant. A few rods from the creeks, on either side, and collecting in summer or autumn ceases. A few forms of life may be found, however. Hiding in the withered clumps of *Balsamorhiza*, *Lupine* or *Cranesbill* are hundreds of the big, black, and rapacious Rocky Mountain crickets. Over the dry duffalo range they hold sway with the departing king of the plains. When startled from their hiding place they give a series of loud, shrill, and startling noises, accompanied by vigorous bodily movements, which invariably startle the collector. A few grasshoppers live in the same region. Now and then a battered and frazzled butterfly, *Pieris protodice* or an *Argynnis*, flutters feebly past. In the buffalo range and over most of the valley there are no trees save along the water courses. The sparrow hawk is frequently seen on the wing or perched upon a rock. Other and larger raptorial birds circle in the air or are busy at the dead carcasses on the plain. Not infrequently a coyote is observed skulking near the herds of cattle, and even bears come down from the mountain sides into the timber along the creeks.

Collecting has been done at various places in the reservation and along the shore of the lake, in spring, summer and late fall. The reservation and the lake are crossed annually in going to and from the Station. Plate XLVI shows the most of the lower end of the lake, viewed from the moraine. The absence of timber will be specially noted. The swamp area, in which is the greatest amount of life, is to the right, extending to the mountains, not shown in the plate. On the left may be seen the outlet, the Pend d'Oreille river, which is about a mile wide, crossed by an old fashioned ferry, propelled by oars made from pine poles. The chain of islands which almost cuts the lake in two is plainly visible, the main lake lying beyond the islands. During summer the water in the visible part varies from 20 feet in depth to a shallow swamp. The postoffice, Polson, on the lake-river bank, may be located by following the road. Boats plying across the lake land at this place. The river is not navigable.

The Buffalo Herd.

So much scientific interest centers in the fast disappearing and almost extinct buffalo that a few words on the herd now roaming the plains in the Mission valley may not be out of place.

The buffalo herd ranges in the Mission valley, west of the main travelled road. They may be on either side or both sides of the Pend d'Oreille river. West from Stinger's ranch, twelve miles from the lake, is a large butte, rising from the plain. Near this some of the buffalo are quite likely to be found. Leaving the road at or near Stinger's the visitor may see the herd with a couple of hours travel. It is not likely the entire herd may be seen in one place.

Eighteen years ago, in 1884, Charles Allard and Michel Pablo bought of an Indian named Samuel ten head of buffalo, which the Indian brought from east of the Rocky Mountains. From "Buffalo" Jones, in Nebraska, they purchased 44 head, 18 of which were graded stock. From this beginning of 36 full blooded and 18 graded animals the present herd has descended.

At the present writing, February, 1902, there are on the reserve 220 full blooded and 65 graded animals. During the past year there have been sold nearly one hundred animals. In the years past others have been sold, but the number is not determined.

Twenty-seven head were sold to Conrad of Kalispell, and are now cared for on Conrad's ranch. Between 40 and 50 are said to have been sold to a company, the majority to stay on the Reservation, the others to be used in the show business. Several were sold to Iowa parties.*

In 1901, 65 calves were added to the herd. About half are reported to be males. Many of the males are castrated. About half the cows are said to have calves each year. The cows do not have calves until they are four or five years of age. It is claimed that the fertility of the herd is not decreasing. A portion of the calves die or are killed, about the same proportion as for ordinary cattle on the range.

A calf not over 30 seconds born was upon its feet, and not over 20 minutes old showed fight, as stated by Joseph Allard, who owned it.

Half-breed cows are fertile, either with buffalo or cattle. Half-breed bulls have not been tried and are not reported.

The stags show many differences in build from bulls. The principal difference to be noticed is in the horns, which are longer, probably larger, standing out farther from the head.

Twenty-seven of these animals were recently taken to Plains in order that two might be selected from the number. Five men were driving the animals, and even then a half dozen got away. They would not follow

* 25 were sold in the fall of 1902 for use in the Yellowstone Park. In October the guardian of the minor children requested permission of the court to sell 60.

the road, but went up and down hills as they pleased. They are sure footed, quick and nimble. The cows are always on the alert to see an opportunity to escape, and move very quickly. After escaping they immediately return to the herd.

The animals paid little attention to barb-wire fences, and went through on many occasions. After they were put into the high fenced corral at the stockyards they mashed down the gate, several escaping.

In crossing a river with ice it is necessary to make a good trail with horses, so the tracks may be visible, otherwise they will not cross. They look first at the near side, then at the far side, then dash across. An old bull will probably lead, when all will follow. They are sure footed, and take ice as easily as a shod horse. They plunge into water without hesitation when separated from the herd and are returning and swim easily and rapidly. The cows are much harder to handle than the bulls.

They usually range in two main herds, but in the winter of 1901, they were in three herds. These are further split up into small bands of from a few to several dozen.

The range of the buffalo herd is along the Pend d'Oreille river, in the Flathead Indian reserve. Occasionally they wander into the cultivated fields of the Indians and squaw men. They range over a territory 8 to 10 miles long and about as wide. With them are many herds of cattle and horses. It takes a practiced eye to determine whether a speck on the horizon is a herd of buffalo, of cattle or of horses.

A herder is kept with the animals continually. He knows where they are, keeps note of the increase, looks after the calves and the herd generally, much more closely than for domestic cattle.

Every Christmas season a few of the largest and finest bulls are sold to the butchers of the adjacent large towns, Kalispell, Missoula, Butte and Helena. These are sold over the counter as meat, while the heads are retained as mounts. Considering the few remaining animals in the world this seems a public calamity. But as the herd is owned by private individuals to whom appeals for the public interest and for science are of no avail, and who by law may do as they please with their own, the business is likely to continue. The price put upon the animals when sought by eastern people for parks and zoological gardens is so high that sales are almost out of the question, since the freight haul is long, the tariff high, and danger of death before the end of the trip not improbable. It is too bad some means cannot be devised to save the lives of the large fine bulls slain annually. It is claimed, however, that most of the animals thus killed are stags.

The steps one must take to see the herd are about as follows: One may either ride on horseback or take a rig, preferably a buggy. If he is wise he will also secure the services of an Indian as guide, to locate the herd and "round up" the smaller herds into one large bunch. There is no telling where the herd will be on the range. As a consequence the Indian starts out toward the high butte near which they are most frequently found. When a herd is sighted the guide will ride toward it until he can determine whether they are buffaloes or some other animals. In the latter case he takes another direction until another herd is sighted. It not infrequently happens that one travels for hours before seeing the

herd in the distance. In one instance the writer with a party was in the immediate vicinity, and it required most of the day to see the herd and return to camp. Usually one can see the herd with little difficulty, and it is well worth a day's work and the slight expense.

The animals go in small squads of from two or three to fifty. The Indian guide races his cayuse after a squad, coming up in the direction he wishes them to go. He will ride leisurely until he reaches the position that suits him, will then turn toward the squad, spur his cayuse to full speed, shriek like a demon, and fire his six shooter again and again. The squad is run in the direction of a larger squad. When they are joined he goes in search of others and repeats the same performance, until his cayuse will be panting and reeking with perspiration. Occasionally he will approach the visitor and stop at a respectful distance, sitting idly in his saddle. If the visitor says nothing no more will be brought up. If the visitor points to others or asks for more they are likely to be brought.

One may go within 20 to 30 yards of the animals. If closer approach is made they will slowly move off. If the pursuit is continued they will hasten the gait to a trot, then to a gallop, and finally run at full speed with lowered head and straight tail, bellowing every few jumps.

The guides are very positive the beasts will do harm to one on foot. There are several bad animals in the herd, and most of them will "stand pat," as expressed by one of the owners.

The writer has tried to go among them on foot, for photographic purposes, but they have invariably decamped. The first time they were viewed there were over 200 in the herd brought together. They were continually bellowing in their low, deep and rumbling gurgle. They would keep pawing the earth and stirring clouds of dust with their hoofs. The large masses of unshed hair in spots was a decided contrast to the sleek places where the hair was new. It is well known they shed in masses of hair. The young calves in color resembled Jerseys. The old bulls were noble looking fellows and looked large. Not a tree is on their range, save a few scraggy pines on the rocky buttes or along the river. The entire herd may be in a coulee but a few rods away and be invisible. It certainly is an unusual sight to see such a large herd on such a range; while the guide with his wide sombrero and leather chaps, his heels adorned with long clanking spurs, lends a charm that is more than passing. He eyes them constantly, answering questions with one of three answers, "yes," "no," "I don't know." Diligent inquiry may bring information, but it will not be volunteered by the guide.

The inspection over the guide gives a whoop, fires his six shooter, spurs his horse at them, follows for thirty or forty rods, shrieking, shooting and spurring his horse on, when it is over. They soon scatter, and are mostly out of sight. They always appear restless, and are seldom standing quietly, as cattle or horses often stand.

To make a visit to the herd is not difficult, and any number of photographs may be secured.

The country over which they roam is near the Pend d'Oreille river. The soil is sandy, held from blowing by vegetation. There are numerous

coulees and a few high buttes. To the east the Mission range, snow-capped in winter and clothed in dark green during summer, makes an imposing view. Occasionally in winter, when the river freezes, the herd crosses the river and give much trouble.

In the large bay of Flathead lake extending west from the main body of water is a large island, named Wild Horse Island. Its location may be seen by consulting Plate XXXVI. Several years ago about 75 half-breed buffaloes and four full blooded bulls were placed on this island and left to roam. The island is several miles long and not quite as great in width. It is well timbered, and rises several hundred feet above the lake. The writer has not been on the island, but has been around it on the water. No one lives on it. Rarely is it visited, even by Indians. It is entirely within the Flathead Indian Reservation.

The buffaloes staid on the island for a couple of years, but did not like it. They began swimming to the mainland, a mile and half away, continuing thus until but a few were left on the island, when they were removed.

This short record shows what can be done by private enterprises, and that the work of the Indian. In twenty years a hord of 36 has increased to more than 350, or ten times the original number, with no record of the many sales that have been made during most of the time. In 20 years the number of calves is given per year at 65, more than double the original number. The range on which the herd is kept certainly does not exceed 70 to 100 square miles, and they could no doubt be kept on a much smaller range than this.

There is this noticeable difference between the Allard-Pablo herd on the Flathead Indian reservation and the herd in Yellowstone Park, to which so much attention has been directed, and which has done so much toward forming an opinion in the minds of men adversely to further attempts to save to the world a herd of these noble animals. The Allard-Pablo herd has a man with it constantly. The animals are therefore accustomed to man, and are not alarmed at his approach. The Park herd were rarely seen by man, and were not carefully looked after. The Park herd were placed at a high altitude, over 7,000 feet, where snows were deep, winters long and severe, and where it was very difficult, perhaps impossible, to give them aid in case of scarcity of food. The Allard-Pablo herd has a range at altitude below 3,000 feet, where deep snows do not occur, and where poachers cannot molest without fear of discovery. Moreover, hay or grain may be taken to the herd in a few hours in case of necessity. While they range in a treeless valley, they have in the range coulees, morainal depressions, river and creek banks, which offer shelter. Several high buttes offer protection from the wind, while the river, creeks and ponds supply abundance of water.

From a careful study of the facts it will become apparent that Congress should not cease in its efforts to save the buffalo from extinction. An appropriation of \$8,000 will purchase 25 cows and a dozen bulls. If purchased from several different herds there is little danger from inbreeding. This is as large a herd as Allard and Pablo had in the beginning. With the same care exercised over this herd in 20 years the increase from 25 cows and 12 bulls should make the herd number between 400 and

500. Now, there are large tracts of land leased annually for small sums to large cattle dealers. There are large tracts in Indian reservations which can be utilized for some such purpose more legitimately than to lease to cattle men for stock. If a tract of land containing from 50 to 100 square miles were set apart for this particular use, with an appropriation at the beginning of \$15,000, and an annual appropriation of \$5,000, there certainly should be no difficulty whatever in developing a herd from a small beginning to one that would be a credit to the nation.

The government and care of the herd should be placed under the jurisdiction of the Biological Survey of the Department of Agriculture. The men in the Survey are keenly alive to the importance of an attempt to save the buffalo from extinction, and may be relied on to look after the animals as carefully as they are looked after in any zoological park.

It is hardly to be expected that the animals will thrive in the Yellowstone Park, where the winters are long and severe, the summers short and concentrated, and where protection is likewise afforded to the wild animals which prey upon the calves. The buffalo, unlike the deer and elk, seems to remain in a limited territory. If they are to thrive and multiply, they must be looked after and cared for. With a range in Montana, Idaho, Arizona or New Mexico as mentioned above, with a small herd under care of the Biological Survey of the Government, a small appropriation will, with proper handling, produce a large herd in fifteen or twenty years.

It is to be hoped that the recent small appropriation made by congress for the preservation of the buffalo will be sufficient to protect it from extinction. It is doubtful, however, whether they will ever thrive in the Yellowstone Park without much care in the winter. A lower altitude, with less snow and longer summer, similar to that of the Flathead Indian Reservation, will insure the safety of the herd with small amount of attention and expense.

Flathead Lake.

The following report of the lake was prepared by Fred. D. Smith, formerly Professor of Chemistry and Geology at the University of Montana, now mining engineer at Sumpter, Oregon. The paper was prepared while he was connected with the University, after he had made an extended trip around the lake and over a large portion of the country adjacent.

The lake occupies the lower portions of an immense valley that reaches from a low range of hills along the Jocko river northward across the British Columbia line, and which has a total length of over 100 miles. Tobacco Plains on the north are a part of this valley though separated from Mission valley by a low range of hills. This larger valley may be considered made up of three smaller ones, viz: Mission, south of Flathead Lake; Flathead, north of the lake, and Tobacco Plains still farther north.

Mission valley has a general elevation of from 100 to 250 feet above the lake level and a length of about 35 miles north and south with a width of from 5 to 10 miles. Flathead valley has a slight elevation of from 20 to 50 feet above the lake and is much more regular in its surface contour and its width. Its length is about 40 miles and the width 8 to 10 miles. These two valleys are the more important in this discussion as each illustrates a geological process bearing on the history of the lake. (The lower portion of Flathead valley may be studied from Plate XXXVII.)

The present lake is the remnant of the much larger lake that occupied these valleys in Tertiary times, as shown by the lake beds in both valleys as well as in the valley through which the Jocko river flows. As yet little, if any, investigating for vertebrate fossils has been done in these beds though it is probable that they are of the same age as those of Flint creek and Madison valley studied by E. Douglass.

Mission valley and the lake are bordered on the eastern side by the Mission mountains, a range which rises abruptly from the plains to great heights. These mountains, with a very steep western slope, have their summit within relatively short distances from the valley and consequently the streams therefrom are neither large nor of great volume in discharge. On the other hand the eastern slopes of the mountains are long and gradual, thus furnishing a larger drainage area to the Swan river and Blackfoot tributaries which receive the waters. This range, as such, appears to terminate at a point near the upper end of the lake where the Swan river, changing its course from northward to west and south westward, flows into Flathead lake. Another range, the Swan range of the Kootenais, some 12 miles to the N. E. continues to be the border of Flathead valley in a manner similar to that of Mission range just explained.

The history of these valleys or of the one larger valley, when all are considered as one, is very interesting. The Mission mountain range was caused by a fault, having a general direction of north and south, with a

stronger throw on the southern end. This resulted in a much larger slip on the southern end of the range than on the northern. In fact the slight slip on the north together with the erosion by weathering and valley glaciers has resulted in a complete termination of this range, per se, near the University of Montana Biological Station as noted above. The slip must have been several thousand feet at the southern end as the peaks near the St. Ignatius mission are 7,000 feet higher than the plain below. The weathering following the elevation of this range has left the escarpment in jagged and precipitous cliffs making the range one marked by most picturesque scenery.

With the most superficial study only, it is suggested that the range noted above, the Kootenais, N. E. of the Mission range and forming the boundary of Flathead valley, was probably formed by a similar fault. The range of foothills which forms an irregular boundary of the Mission valley and of Flathead lake on the west, reaches westward to a considerable size and shows the strata once continuous with those of the Mission range. They were evidently depressed coincident with the tilting of the Mission which movements, together with the erosion in the trench like valley formed, left about the long valley extending 100 miles north and south.

Such a valley likewise is the Bitter Root valley, though the peculiar feature of this larger valley under discussion is that while the other valleys of similar history in the state show plainly by their drainage that erosion by streams and rivers has played an important part in the cutting and enlarging of the depression along the fault plane, this one by its peculiar termination at the Jocko hills on the south and by its entire lack of evidences of stream courses from Flathead lake to the south end gives indications of a different history. More detailed study may show that the valley was once occupied by a large stream, or that the drainage, unlike that of to-day, was to the northward instead of southward.

The Jocko hills may have been faulted or raised after the valley erosion had been finished. I have never been able to find any record of excavations in the valley bottoms by which could be learned the depth of the soil and gravel to the rock.

It has been noted above that the Mission valley has a general elevation of from 100 to 250 feet above the lake while the Flathead valley is much more regular in its surface and is but slightly elevated above the lake. These two valleys are of different history in so far as the bottoms are concerned.

Flathead valley plains show clearly that the soil is made almost entirely of sediments deposited in the still waters of the lake. This accounts for the level character of the plains. Little if any glacial deposit has been formed in this valley. Some is found in the rounded hills near the mouth of Swan river and along the eastern border of the valley below Kalispell. These are undoubtedly closely connected with the glacial deposits found nearer Swan river valley. The lake which filled the valley certainly much higher than at present evidently receded rapidly as I have been unable to find any bench marks or terraces on the hill-sides. However it apparently receded more slowly after it had reached the level of the Flathead valley sediments as several old stream courses are plainly discernible between the town of Kalispell and the lake.

The plains of the Mission valley have a much rougher and more irregular surface due to the moraines and other glacial debris deposited over much of the valley. The long hill extending diagonally across the valley directly at the foot of the lake is clearly glacial drift as shown by the irregularly distributed clay, boulders, rounded pebbles, etc. The form of this suggests that it may be classed as a drumlin.

Along the eastern side of the valley are seen many rounded knolls enclosing small marshes and ponds which are all clearly of morainal origin. The small ponds found scattered over the entire valley which contain water most of the summer are probably formed by the depressions in the surface due to glacial deposits. These are plainly shown in Plate XXXIII. Small glaciers undoubtedly flowed from the Mission mountains along its entire length but these deposits must have come from a very much larger glacier, probably from one which came down from the north throughout the whole valley.

The lake in its higher elevations probably had its outlet in a western direction as shown by the old stream course to the westward of the large bay behind the large islands. A stream course near the town of Dayton leading southwestward down the valley of the Little Bitter Root is very plainly discernible.

When the lake reached its present level it found its outlet across the lake beds alluded to above, and through the moraines down its present course, the Pend d'Oreille river. This is plainly shown by the high cliffs of clay and other sediments that still retain their perpendicular sides along the canyon of this river. The increased head of the water in the lake above and the canyon cut below furnished the tools for the outflow to cut its canyon rapidly and the beautiful Pend d'Oreille rapids near the lake at Polson are the result. (These rapids are shown in Plate XLV.)

Flathead lake now forms but one element in the drainage system of the upper valley and the territory beyond the Mission and Kootenai ranges. The entire drainage from this section of the state flows into the lake through two rivers, viz., the Swan and Flathead rivers. The latter is made up of three large rivers known severally as the North, South and Middle Forks. These three streams by their confluence above Kalispell form the Flathead river. This river is very interesting in itself as from its fall and other characteristics it shows itself to be but an arm of the lake. When the lake receded to near its present level, the drainage from the north and northeast flowed across the sediments cutting an irregular channel, meandering across the plains until sufficient fall of the lake level was reached to allow it to cut enough channel to hold the stream. At present it winds its circuitous path across the plains and has a total length of about 35 miles while the distance as measured in a straight line from the forks above is but 15 miles. In general its width is from 300 to 800 feet, and its depth is in some places 75 feet. On account of the sluggish nature of the current of this river the erosion of the banks is slight except on the sharp curves, while the deposition in the bottom of the river and at its mouth is very rapid.

The northern end of the lake into which all of the drainage is poured

is apparently composed of sediments deposited in the manner mentioned as a large delta. The course of the river is plainly traced into the lake for some distance by the delta thus formed, which for a distance of from one-fourth to one-half mile from the shore is sufficiently high to be covered by vegetation and in some places by shrubbery. Beneath the surface of the water the formation is discernible for a long distance farther into the lake. Consult Plate XXXVII.

The opportunities for interesting and valuable geological study in connection with the Station are therefore apparent at first sight. Whether in connection with a study of the bottom of the present lake or as a separate study of the glacial deposits along the valley north to the boundary the study will be both of value and of interest. To students who have had some general work in geological study the field is a most promising one. A study of the valley from the upper end of the lake northward with particular reference to its relation to the older lake and river will certainly afford work for many students. This portion may be a delta itself or only the sediment of quieter waters. Beyond all of these questions a study of the territory within greater distances, especially north of Kalispell and around the divide between Swan river and the Big Blackfoot tributaries, may bring out information that will throw great light on the history of many other portions of old topography of the western slope of the Rocky mountains. The Mission mountains will prove to be an interesting study from the petrographical standpoint as will also the Kootenais. In view of the recent developments in the study of the Miocene Lake beds of Montana it would seem that Flathead lake offers a great field of study as both ancient and recent beds can be studied at once."

In addition to the above notes by Mr. Smith may be given the following:

The outlet is called by some Pend d'Oreille river, by others Flathead river. Some consider Flathead river to extend from its source to the lake, then from the lake to the Missoula river. Others give the name Pend d'Oreille to the stream from Flathead lake to the Missoula river. The river formed by the junction of the Missoula and Pend d'Oreille is called Clarke's Fork of the Columbia.

The present outlet of Flathead lake is of recent origin. The river for several miles near the lake is swift and rocky, a series of rapids alternating with more quiet water. About a mile from the lake there is a large bank of clay through which the river has cut. The clay is continuous with and apparently a part of the moraine mentioned. At the river bank it has been cut and eroded by the wind and rain. The bank is abrupt and steep, the clay clinging together so as to form cliffs, some ending in sharp pinnacles. Below the clay is the bed rock, similar to that found at different places around the lake. The river has done some cutting through the solid rock bed, but not much. At one place the channel is partially dammed by a large rock in the center of the river. Above and below this place the river is a beautiful sheet of foam, with several small falls. It is as beautiful a rapid as one usually sees. In my estimation it is superior to the rapid above the first falls in the Yellowstone. Plate XLV shows the rapids as seen from the hillside some two hun-

dred feet above the water. This is a great fishing resort for the Indians on the reservation, and one seldom visits the place without seeing several topees on the bank some place near. The osprey is as industrious as the Indian, and is seldom absent from the scene when one visits the rapids.

The moraine at the lower end of the lake is worthy of more extended notice. Between it and the lake is a level plain. At the western end, where the plain is widest, it separates the moraine from the lake by a distance of about two miles. Eastward the hills come almost to the water's edge, separated only by a narrow strip of level land.

This level plain shows clearly two terraces, with evidences of a third higher upon the hillside. The terraces correspond with similar terraces at the northern end. Here one is beautifully shown at Sliter's, near the Station.

The lake has therefore had two, possibly three levels other than that at present.

The moraine is 450 feet above the level of the lake, at the place where the wagon road crosses near Polson. There are probably several places higher than this. The railroad survey crosses the moraine about midway between the Pend d'Oreille river and the mountains. Their readings show the height at the river to be 84 feet less than that at the place selected for passage. The engineers preferred the higher passage because the lower necessitated doubling back in order to get down on the southern side.

The wagon road winds back and forth in its passage over. The lake is invisible until the traveler reaches the crest of the hill, when it comes suddenly before him in all its beauty. The view of the lake proper is obscured by the islands and peninsula, which practically cut the lake in two. The view of the lake from any other point is better than that from the lower end.

The banks of the lake do not afford as much shelter for invertebrate life as would at first seem apparent. The southern third, cut off by the islands, is shallow, nowhere of greater depth than twenty feet. The eastern part of this bay, formed by the peninsula projecting from the Mission mountains, is very marshy, with muddy bottom. Rushes and weeds grow abundantly, offering an excellent harbor for smaller life. This is the largest marshy region around the lake. Between the mouth of Flathead river and the mouth of Swan river, along the northern shore, is another marsh in the spring, of peculiar nature. At the water's edge is an embankment of a more or less rocky nature. North of this embankment is a shallow marsh, about two miles long and a quarter to a half mile wide. When the lake rises, as it does in the spring, from ten to twelve feet, the water flows over the embankment, and into the low land. As the lake recedes the imprisoned waters cannot escape, and offer a fine breeding place for mosquitoes for some time, until the waters evaporate or filter through the soil to the lake region. Most of the remaining banks are rocky, precipitous at the water's edge, with or without a gravelly beach. The bottom generally is reported to be rocky, with little mud. This report comes from the captain of the boat Klon-

dyke, who has anchored all over the lake; his experience on the lake extends over a period of many years. Compared with the size of the lake the swampy country is small. From this it would appear that the breeding grounds for most of the fish must be in regions distant from the lake, causing long migration periods. This is made more apparent from the fact that fish are rarely caught any place in the lake except at or near the streams entering the lake, or at the outlet.

Flathead lake is popularly supposed to be very deep. I was told it was 1,500 feet deep in places. During the summer of 1899 some twenty soundings were made in the lake and rivers. The greatest depth obtained was 280 feet. The location of this may be found by referring to the map. Eugene Hodge, captain of the Klondyke, states that nowhere is the water deeper than this sounding.

McGovern Bay, on the northern end of the lake, is about seventy feet at the deepest. Flathead river has filled in a large amount of sediment. East of the mouth of Flathead river the drop in depth is sudden from the river bar. The deepest portion of the lake is off shore on the east side, next the Mission mountains. In high water a great deal of land at both ends of the lake is covered. If the depth of the lake should be lessened by ten feet, thousands of acres at the lower end would be uncovered. The annual rise and fall of the lake is from ten to fourteen feet, but it has risen as much as nineteen feet in a season. The lake acts as a huge reservoir for water storage, but overflows much land almost every year when it is at the highest. The amount of water flowing into the lake and out of the lake annually has not as yet been determined.

Life in Flathead is scarce. Although some species are taken in great abundance, the cold clear waters, with rocky bottom and banks and with few marshes, make life scarce as compared with similar bodies of water located in warmer climates at lower altitudes.

It is impossible to present the results on Entomostracan work in this paper. These results will be prepared separately. The work of collecting has extended over four seasons, and many data have accumulated.

During the summer of 1899 collections were made on various portions of the lake. Report of this work has been made. In 1900, collections were made by Prof. L. A. Youtz, then of Montana Wes. University, now at Lawrence University. In 1901, Maurice Ricker, of Burlington, Iowa, carried on the investigations. These studies have been made in but two months of the year, July and August. It is important that collections be made during other months of the year, in order that seasonal changes may be studied.

In 1902, collections were made during the months of July and August by Maurice Ricker and the writer. Pumpings were made almost daily, as the weather would permit. Specimens were taken at depths from surface to 120 feet.

Collecting around shore is confined to the country adjacent to either end of the lake. On the eastern bank the Mission mountains come down to the water's edge, with a few benches at different places. There are no large streams entering the lake from the mountains on the east. In the 30 or 35 miles of bank there are only four or five small streams of

water, any one of which one might step across. These lead down through deep and steep canyons, with dense underbrush, fallen logs and boulders. Botanical collecting is good. Insects are not abundant. The birds have been noted. The shells have been pretty well worked up, as far as species are concerned.

On the west side there are two large creeks, Dayton creek and Big creek. The former enters the large arm of the bay. Lake Ronan, which it drains, has not yet been visited. Indeed, no collecting has been done on the west bank of the lake. Big creek is near the northern end of the lake, flowing into McGovern Bay. At the mouth of the creek there is some low and marshy land, small in extent. The lake a few feet off shore is deep. The bay near its center is seventy feet deep.

On the west the mountains come down to the water's edge as they do on the east, though they are not so abrupt nor so high. The reservation line passes north of the wide bay at the lower end, thus placing much of the Dayton creek low land within the reservation. Settlers have taken up land along the lake, on both sides without the reservation lines, and the proximity to the lake makes this land very desirable for fruit raising. The region about Big creek has not been examined. No explorations have been made in the mountains west of the lake.

As has been stated, the water of the lake is received through the Flathead and Swan rivers. The annual rise of the lake in 1900 was 8.3 feet. That year was one of low water. It is claimed by those in a position to know that the water has risen as much as seventeen feet during a season. Since the lake has an estimated length of about 30 miles, which will for convenience be made 25 miles, and an average width of from 8 to 10 miles, no doubt more than this, it will be seen that the water held back by this lake in storage is sufficient to cover an area of from 200 to 300 square miles to a depth of from 8 to 17 feet. Swan lake, a few miles from Flathead lake holds the waters of Swan river in similar manner from passing to Flathead lake.

The amount of water flowing into Flathead lake, or out of it, has not been determined. In 1899, two gauges were established on the lake by the U. S. Government, one at the upper and one at the lower end. These were continued for a little over a year and were discontinued for lack of funds. But one measurement has been made of Swan river, none of Flathead.

The air currents of the lake are numerous, and worthy of extended study. Rarely is the water perfectly calm. It has been seen, however, so still that shore objects were beautifully mirrored. The mountains on such occasions show up grandly in the reflection. A ride across the lake at such time is rare, but it is one never to be forgotten. In the evening when much of the pumping was made for entomostraca there were many occasions when the water was comparatively quiet. Usually, however, a breeze was blowing.

During the summer the wind on the lake is from the south or southwest, the prevailing direction of the region. The general or prevailing winds in the summer are as follows: In the morning there is a gentle breeze down the lake from the north. Soon this dies away, and the wind

springs up from the south, increasing until early in the afternoon. Toward evening the lake becomes quiet. About dusk a light breeze blows out on the lake from the mountains. At the laboratory the evening lake breeze is from the east. We have often watched the ripples moving across the water toward our boat, coming from the land, as we were at work with the pump. The mountains cool quickly, the cool air flowing down the sides and across both the valley and lake. Similar phenomena have been noticed on all the lakes of the region.

Opposite Wild Horse Island the lake is widest, here having a total extent across of 18 or 19 miles. This island rises several hundred feet out of the lake, and is almost entirely in the western arm, projecting out from the main body of the lake. From the contour of the mainland it is possible for winds to blow up the lake from the lower end, and across the lake from the western arm. These air currents often meet in the open lake east of Wild Horse. Here the wind is most uncertain and the lake roughest. Winds blowing either up or down the lake may meet other winds from the bay. South of the islands the lake is rarely rough.

But when the lake gets real bad it seems as though Neptune was in a rage and had stirred up the waters to the bottom. In ten minutes the lake may change from a perfect calm to a sea on which small boats will hesitate to go, and which may even keep the larger boats in harbor. The surf beats as in larger lakes. One morning we started home in a 32-foot steamer. A mile out large waves were met coming up the lake which caused us to turn back to keep from getting our valuable material and specimens wet. Three days after a second start was made. We hugged shore for six miles, when the strong wind piled the waters so high we sought the shelter of Wood's Bay. Before we could get to shelter the wind died down so the journey could be resumed. When half way down and we were congratulating ourselves on crossing the widest part without trouble, a wind sprang up which increased in a few minutes to such proportions that the pilot was wet from head to foot, and we were obliged to seek shelter behind the nearest land, an island. In about three hours the journey was resumed. In the evening the lake was quiet.

During the summer, June, July and August, the lake is comparatively quiet, and the winds as given above generally prevail. In spring and fall they are uncertain, and may come up strongly from any quarter in a short time. On the occasion mentioned when waves turned us back after starting homeward the waters were driven by a strong south wind. On entering the harbor, the mouth of Swan river, a little over a mile of travel, a light breeze blew from the north east, apparently from the mountains. All day the waves rolled, but subsided toward evening.

As a result of these conditions small boats work close in shore. Row boats seldom go far out in the lake. To attempt to cross the lake in one would be very unwise. Fatalities do not occur because people are careful. As most of the residents are unfamiliar with boats in rough water and necessity does not drive them on the lake there are not likely to be reckless or foolish trips in rough water.

In the summer of 1902 a dam was constructed across the river at the outlet of the lake. This dam was made as follows. Piles were driven

by machinery into the river bed eight feet apart. The row of piling extended across the river from side to side. Two inch plank were nailed together side by side in threes, fastened by strips. Each set of three planks was then pushed down into the water, held by the current against two posts or piles. The ends were therefore between the piling, and could not be fastened. The idea was to hold back the lake water, prevent the surface from getting low in winter, and thus have depth of water sufficient to float logs at the new mill at the north end of the lake. In low water it is difficult to get logs to the tramway. What the result may be is in the future. The farmers at the upper end of the lake want the water to run out faster, so as not to flood the land. If the scheme of holding back the water succeeds in winter it is likely to succeed in spring when the waters are high. In that event the flooding of land above will be worse than ever. It is probable, however, that the dam will be taken out in the spring by ice.

Daphnia Pond.

Daphnia pond, so-called on account of the great numbers of *Daphnia pulex* found in it, is a small pond of some ten to fifteen acres. It is about a mile and a half from the Station, alongside the regular wagon road, and only about a half mile from the lake, but at a little higher altitude. This pond is no doubt of glacial origin. In the center the water is about twenty feet deep, but for the most part the pond is shallow and overgrown with rank vegetation, offering an excellent harbor for smaller forms of life. No fish have as yet gotten into this water, and consequently the invertebrate fauna is not affected by them, and has few enemies. It is a typical place to study some of the forms of life found therein, living as they do under very favorable conditions. The varied and abundant life in this small pond is in strange and striking contrast to the limited quantity and paucity of species in the large lake, so short a distance away.

Being in such close proximity to the laboratory it has received considerable attention, and is a favorite resort for those seeking material. In or near Daphnia pond may be found the following specimens:

SHELLS.

Planorbis trivolvis Say; abundant.

Sphaerium partumeium Say; abundant.

Physa ampullacea Gld.; rather common.

Pyramidula strigosa cooperi W. G. B.; in damp places along banks of Flathead lake.

ENTOMOSTRACA.

Daphnia pulex; exceedingly abundant, making the color of the water dirty red. May be taken by the spoonful or pint.

Diaptomus lintoni Forbes; common, but much less abundant.

Cyclops pulchellus Koch; not uncommon.

Gammarus, probably two species, one large, an inch in length, swimming among the water lilies.

ODONATA.

Aeschna constricta, Say; abundant; exuviae to be had in quantity on the rushes and cattails. The adults are on the wing in large numbers in late July and early August. During the first week in August, 1901, an American bittern, *Botaurus lentiginosus* Montag., was shot whose stomach was crammed with dragonflies of this species.

Libellula pulchella Drury; next in size to the preceding. Emerges before August.

Libellula quadrimaculata; on the wing as early as July 8 in 1901.

Lestes unguiculata; Hag.; in 1899 this species was emerging in large numbers during the last two weeks in July. In 1901 they were just emerging July 8.

Lestes disjuncta; in smaller numbers than preceding, emerging at the same time.

Enallagma calverti Morse; on the wing early in July; the most abundant of dragonflies at the pond.

Enallagma praevarum Hag.; a few specimens captured.

Sympetrum scotica Donovan; rather abundant in 1899. Scarce in 1901.

Sympetrum obtrusa, var. *assimilata* Uhler; perhaps the most abundant dragonfly in Western Montana.

Ischnura is not uncommon in the vegetation near the water's edge.

The above list is not large, but is about as many as one usually finds in any one locality in the state.

Other material to be found in the pond in abundance may be mentioned; many beetles, dipterous larvae, two leeches, several case worms, many water bugs and worms.

The vicinity of this pond is a great breeding place for birds. It is here that the ornithologist may do some good work. To give a list of those choosing this for a nesting place is unnecessary repetition, as this has been given elsewhere. No fewer than forty-five to fifty migrants build their nests and rear their young within a hundred yards of the water's edge. For so small a pond this is certainly a remarkable showing. On all sides the timber has been destroyed by fire. Thus most of the shelter formerly afforded has been removed. The nesting sites are confined to the low bushes along the water's edge, to those which have sprung up on the burnt area, to the dead boles left by the fire, and to the grass and reeds of the pond. Rails are heard daily as they move around among the weeds. Golden-eyes and grebes usually rear their young in the grass. Catbirds, western yellow-throats, flycatchers, chickadees, sparrows, juncos and woodpeckers all are found. The tree dwelling warblers find a few trees near by. Kingbirds may always be noticed, noisily chattering as they leave their perches in pursuit of insects. In this open country the ornithologists of the shotgun or of the opera glass may alike find suitable field for work. It is but fair to our workers to say that very few birds have been killed around this pond.

Frogs, garter snakes, a single species of turtle, and an occasional muskrat, may be found on the banks or in the water. The white tailed deer has often been seen close to the pond, and annually black bears are known to frequent the bushes adjacent in search of berries. Not only is there an excellent field near this pond for study and for gathering material, but the study is frequently intensified by the sudden appearance of a frightened deer or the hasty and noisy departure of a black bear as the collector wanders over the hills.

No attempt will here be made to give the names of species of plants.

The vegetation is abundant, and offers splendid opportunity for studying plant communities.

A short distance below Daphnia pond, along the wagon road, is a second glacial pond, named Estey pond. This is larger than Daphnia, deeper, and like Daphnia teems with life. It has no outlet, and like Echo lake suddenly rose in height a few years ago, remaining to the present at the higher level.

ROST LAKE. (MUD LAKE.)

This is a small lake, elliptical in outline, lying between Echo lake and Swan river. It is but a few miles from either of the preceding, and about three miles from the base of the Swan range. This range rises abruptly from the plain, as does the Mission mountains, and was elevated in a similar manner. It may be seen by reference to Plate XXXVII, the small lake in the center of the illustration. Plate XLIV shows a general view of the lake from the outlet.

The lake is a little over a mile in length from north to south, its width being about two-thirds its length. It is densely timbered with fir, spruce, white and yellow pine, birch, cottonwood, and alder on all sides, with small meadows here and there. Between the lake and the mountains is a gradually sloping plain, with dense forest, crossed by a few small streams whose sources are in the gulches on the mountain sides. The upper end of the lake is very marshy, much of it swampy, with sphagnum bogs and many small rivulets whose waters reach the lake through tortuous channels. West of the lake the forest extends with gradual slope to the low hills along Flathead lake and river. The forest near Rost lake is damp and swampy for the greater portion of the year. So soft is the soil that the few settlers have been obliged to corduroy the winding road cut through the lodge poles for a distance of nearly a mile. Most of the country about this and Echo lake supports a dense undergrowth of thimble berry bushes.

The lake itself is shallow, with deep mud bottom. In most places the water is but a few feet deep, in no place was it discovered to be more than eight or ten feet. In the shallow water a long ear could be pushed down full length in the mud. As a result of this surface of shallow water the sun's rays in summer warm up the waters more than in any river or pond of the region, and the animal life and vegetation is correspondingly rich and varied.

In early September, 1902, the waters of the lake were remarkably shallow. The passage up and down the lake was made several times in the canvas boat, carrying two men. With this load the boat was usually stirring up the mud in the bottom, although the water was perfectly clear. In many places it was almost impossible to row. A few spots were found where the water was three or four feet deep. In landing at the upper end the boat was dragged by the oars through mud to a hummock of grass. We were then obliged to carefully pick the way out by stepping from hummock to hummock. A misstep on one occasion resulted in a sudden drop to the waist before the hands could be thrown out. It was only by quick and active movement that I regained the solid ground.

Immediately around the waters of the lake the growth of native grass is rank. Where it is possible the residents cut this for winter hay.

In 1902, a row boat could land only in a few places, so gradually does the water deepen and so deep is the mud. The vegetation is encroaching on the lake very fast. Rushes, water lilies, potamogetons, and other hydrophytic forms grow even in the middle of the lake. As a consequence, although there are several small creeks bringing water into the lake there is no perceptible current across it.

It would not require much work to lower the outlet so as to practically drain the lake. There is talk of damming the outlet for logging purposes. The idea is to make the water deep enough to float logs in early spring. It is only a little over a mile by section line to the river. The creek could easily be cleared to float logs in the spring. By this plan it is hoped to get at the marketable timber with moderate cost of removal.

The timber in the vicinity of the lake is as follows: Yellow pine, *Pinus scopulorum* Engl., is quite abundant. The young trees of this species are by lumberman termed "bull pine," and are considered very inferior to what they term "Yellow pine."* There can be no doubt that the "bull pine" is but the early growth of the yellow pine. This is one of the most common trees in the western part of the state. In the wet and swampy land about the lake it is not abundant, being displaced or perhaps replaced by others. It is not uncommon to find trees from three to five feet in diameter. The tree is usually tall, free from limbs, making excellent timber.

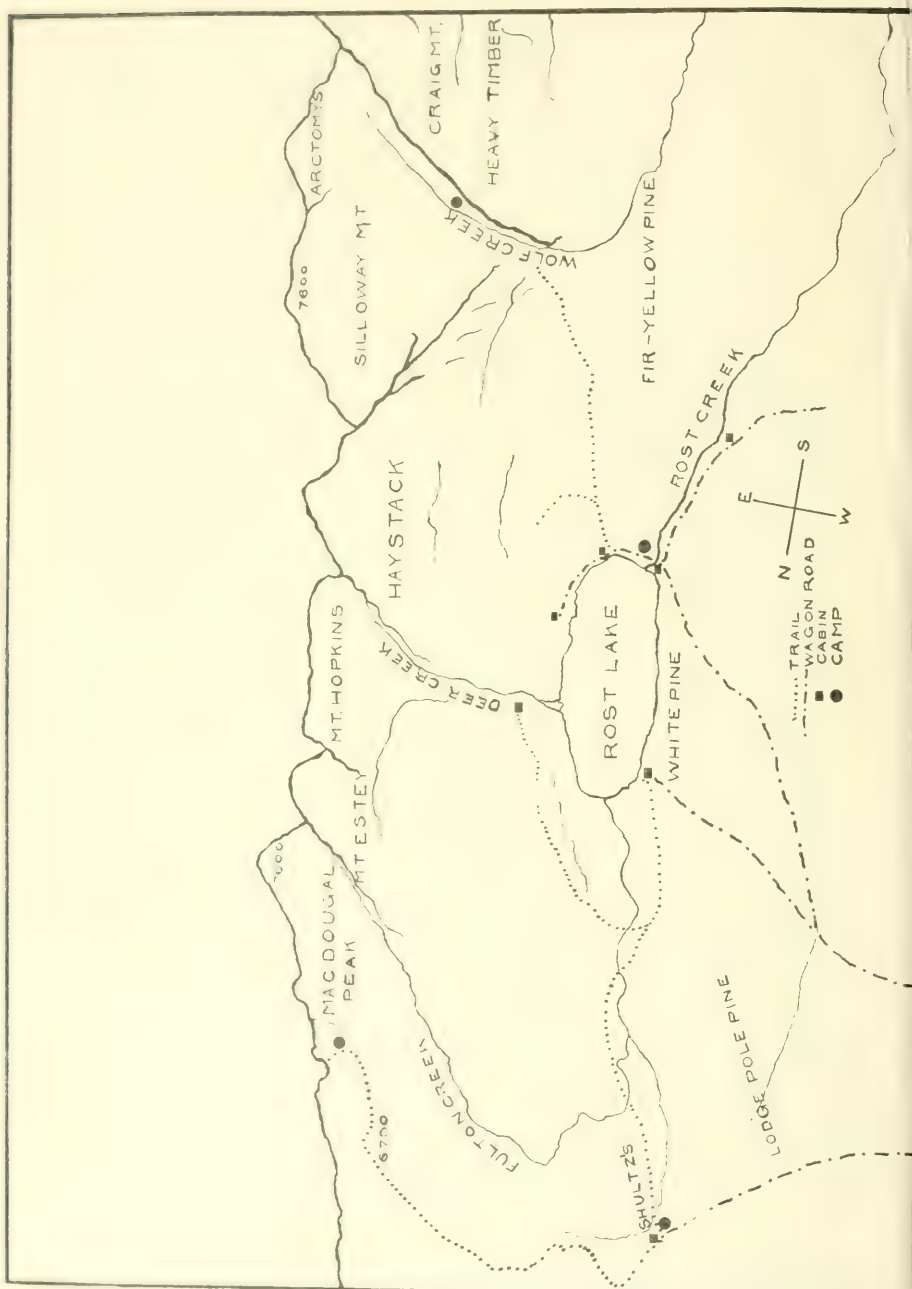
Red fir, or Douglas' Spruce, *Pseudotsuga mucronata*, Raf., is the "oak" of Montana. It is the fir (false fir) of the Puget sound region in a higher, drier, and more unfavorable climate. In the Rost lake region it is not so abundant as some other species, but along the mountain slopes it becomes more common. Westward toward the dry and open prairie it attains considerable size. Between Rost and Swan lakes, a distance of some eight or ten miles, the red fir is very abundant, much of it young growth.

The cottonwood, *Populus angustifolia* James, is found around the borders of the lake and in wet places. Many of the trees are large. In this region there are no cottonwood belts as elsewhere, and the tree may be spoken of as "not uncommon."

Englemann's spruce *Picea englemanni* Engl., is the most abundant tree about the lake, save perhaps the lodgepole pine. It is a beautiful tree, tall and stately. North of the lake is a wet and swampy region with many meadows. Here this spruce is dwarfed, stunted and reduced in size. The trees are not marketable. In other places it becomes a large tree. It does not seem to be so well known among lumbermen as the yellow pine, fir or tamarack. As there are great quantities of this spruce in Western Montana it will no doubt be better known later.

The lodge pole pine, *Pinus murrayana*, Eng., is very abundant in the region of Rost lake, as also Echo lake. In many places it completely occupies the land, apparently to the exclusion of all other timber. In some sections the trees are small, a few inches in diameter and a thick stand. In other places they have attained large size for lodge pole, a foot or more in diameter. The lodge pole is not used for marketable timber, perhaps because the trees are too small. It seems to make good "shakes" and to be serviceable where it may stay dry, as in houses, stables and fences. It is reported to be not good for posts. Corduroy roads are made of it.

* I am informed that lumbermen at Missoula and Hamilton consider the bull pine or young yellow pine superior to the older trees, yellow pine proper.



The white pine, *Pinus monticola*, Dougl., is not infrequent about the lake. Toward the Swan range it becomes more abundant. It seems to be more or less common along the western slope of the Swan range from Swan lake north to Flathead river. Large trees from 7 to 10 feet in circumference are not uncommon, and trees with diameter of 18 inches to 2 feet may be called abundant. This tree has not been lumbered much, and its true worth is not appreciated. However, compared with other lumber white pine is not common.

The western larch or tamarack *Larix occidentalis*, Nutt., is one of the best known trees of the state. There is considerable large timber near Rost lake. The trees are usually tall, clean, and free from knots. Much of the marketable timber of choice size and cutting will be of this species.

The balsam fir, *Abies grandis*, grows abundantly in this wet and shaded region, in some cases attaining the dignity of a tree of from 12 to 15 inches in diameter.

Here, also, the white birch thrives. Many trees large enough for logs are growing near the lake and along the mountain side in the wet region. Many a "curly birch" knot has been seen which from its size would make fine cuttings. The birch of this section will probably be utilized later. *Betula papyrifera* makes a beautiful tree, conspicuous by its white bark. As is perhaps well known, in its early stages the bark is red. It may then be taken for the red birch, *Betula nigra*, L., which is not common in the region. The swamp birch, *Betula glandulosa*, Michx., is everywhere abundant around the border of the lake, growing in large clusters from a common starting place like a rose bush. It even attains to the dignity of a tree, four or five inches in diameter and fifteen or twenty feet high.

The white cedar or arbor-vitae, *Thuja plicata*, Don., grows in considerable quantity in many places in the region. Its value is well known, though little timber has been used except for "shakes" and posts. The cedar timber is practically untouched around Rost lake.

The hemlock, *Tsuga*, grows sparingly, but has not been seen within several miles of the lake. How abundant it may be along the mountains is at present not known to the writer.

Among the shrubs may be mentioned the ever present alder, and the yew. The former occurs along the banks of all the streams. The latter occurs on the mountain slopes, where it is a matted underbrush, spreading over the ground, an impediment to travel, but less difficult by far to penetrate than *Ceanothus* or *Menziesii*, both or either of which may be encountered. It was a rare pleasure to find in late August the ripe berries of the yew. I had never seen them before. The little red cup, the size of a pea, surrounding a central seed, the whole surmounting a slender branch of the evergreen, was very beautiful. They were sweet and pleasant to the taste. As we flushed several fool hens among the bushes the berries are no doubt eaten by these game birds.

It is unnecessary to mention the willows, three species of which were noticed, as they are ever present in the damper places in the valleys as also high up, even to the alpine regions. As Harry N. Whitford, of the University of Chicago, is making a careful study of the forests of the region adjacent to the Biological Station it would be unwise to

fore-tell any of his work or enter the field he has chosen by generalizations as to the influences which have caused the present distribution of the different species of forest trees. All this will be given in his final report, which will be published later, no doubt.

Rost lake is a typical example of a body of water being filled in by sediment and having its inlets, outlet, and sides choked by hydrophytic vegetation. This vegetation is encroaching on the lake in every direction. The annual rise and fall of the lake is several feet, and for a hundred feet or more in every direction from the lake the vegetation was profuse and abundant, at the time of our stay, early July. In the spring the surface of the lake is considerably larger.

The outlet of the lake, Rost creek, carries the water into Swan river. The lake has no driftwood. The inlets are too small to carry drift, and the edge is too swampy to permit forest vegetation close enough to the water to have fallen timber in the water.

This is locally known as Mud lake. It figures on most of the maps as Rost lake, improperly spelled Ross. The name was given because of the early residence at the lake of a Swede named Rost.

The lake is apparently of glacial origin. In a short time it will be filled up. The grassy meadows in the immediate vicinity, all of them wet and swampy, are no doubt smaller lakes or portions of this lake that have been filled up by sediment and hydrophytic vegetation.

As was stated, the animal and vegetable life is quite varied. Clustered about the dead stumps of the rushes were large masses of a fresh water sponge, *Spongilla*, green in color, with long fingerlike arms waving in the water. Very few shells were found. In the creek below the outlet a few young *Margaritana margaritifera* were taken. A single dead *Physa heterostropha* was picked up in the mud bottom, while a few *Pyramidula strigosa* var. *Cooperi* were found in the adjacent woods.

In Odonata the lake showed greater numbers and abundance than any similar region studied in the state. Many species were just emerging from the water. A *Calopteryx*, the first seen in the state and the first reported, was found rather abundantly. *Sympetrum rubicundula* was emerging, July 14, in large numbers, the specimens being fresh and uncolored. *Aeschna constricta* was on the wing, the exuviae being found on the rushes in numbers. *Ischnura* was common. *Libellula pulchella* was just emerging, in considerable numbers. *Libellula quadrimaculata* was on the wing, and captured specimens showed that they had been out for some time. Two species of *Lestes* were on the wing in considerable numbers, the larger number just emerging. A dark colored *Sympetrum* was sparingly distributed, difficult to catch, a single one being taken. *Enallagma calverti* Morse, was quite abundant, some on the wing, others emerging. A *Mesothemis*, *M. simplicicollis*, was occasionally seen, and one was captured on the mountain eastward at an altitude of over 7,000 feet.

Calopteryx yakima Hag. See Psyche, 1889, pp. 248-9.

Hagen described this species from specimens collected at Lone Tree, near the Yakima river, Wash. He says the discovery of a species of *Calopteryx* west of the Rocky mountains was very unexpected and rather

startling, the more as the species seemed to be different from all known to occur in North America. He also says: "I cannot but believe that some of the northwestern species pass east by the passage above Missoula, where the principal range of the Rocky mountains ends, and perhaps by the upper parts of the Columbia river. As far as I know, such species are, until now, not to be found in eastern Canada or in Maine. Of course when species can come east in such a way it is possible that some could go west in the same way, and would be, perhaps, modified by the climate. So I found it necessary to compare carefully with *C. yakima* the *C. hudsonica* from Michipicoten and *C. aequabilis*."

From July 7 to 14, 1901, specimens were captured. The insects were taken from the log bridge at the outlet of the lake, on which they congregated. The collection was made gradually. Perhaps a half dozen would be seen on the bridge or in the rushes. When these were captured or driven off it would be some time before others would assemble. During the week's stay at the lake 26 males and 24 females were taken. They were all well colored, showing that they had been out for some time. They were not seen at Echo lake, a few miles further to the northwest, nor have they been seen anywhere else in western Montana. But dragonfly collecting in Montana has not been carried on very extensively.

Calvert considers *C. yakima* the same as *C. aequabilis*, the eastern insect.

Taking *C. yakima* at Rost lake indicates that this eastern dragonfly has effected passage across the Rockies in Montana, and above Missoula, as suspected by Hagen. Later investigations may show the exact place in the mountains where the species crossed over. It is quite probable that the species has crossed at Lewis and Clarke Pass, whose altitude is 6,323, from P. R. R. reports. The waters of the Missouri and of the Columbia are but a short distance apart, and the pass is low. Since the species has not been seen around Missoula it is likely, if the above pass was the passage, that the species has followed the Big Blackfoot through the upper part of its course and then passed over to the Swan river, and down that to Swan lake, from which opens up the large wooded valley in which Rost lake lies.

It will be apparent to the reader that the dragonfly in question has crossed the Rocky mountains, but that the passage has been from the east side westward, and not as Hagen supposed, from west side eastward. Further, the passage has been recent, since *C. yakima* and *C. aequabilis*, although on opposite sides of the range, have not sufficient marks of distinction to be considered even as separate races.

Since capturing these specimens I now recall an occasion when a single specimen was thought to be seen at the Biological Station. As I was passing through a barn lot on my way to lunch I was sure I saw a *Calopteryx* in the weeds some distance off. I had no net, but grabbed my hat and made chase. I was sure I had seen one glimpse of a *Calopteryx* but was unable to find it.

It is hardly likely the species crossed at the Marias Pass, whose altitude is 8,500 feet. Nor is it at all likely the species crossed over north of this, as the mountains are abrupt, high, and the streams very cold. If the passage has been any place in the range south of Lewis and Clarke

Pass it would be to a stream leading into Clarke's Fork through Missoula, where it has not been seen.

It is hoped soon to make an expedition to the headwaters of the Big Blackfoot and Swan rivers, when the question may be settled.

Few water birds were seen on the lake. It does not seem to be a favorite resort for them. Although there are several species of fish they do not seem to thrive in the warm waters of the lake. It is possible later investigations may show this to be a good breeding place, as Entomostraca are quite abundant. Other forms of animal life, such as larval Diptera and Odonata, leeches and worms have not been determined except in case of adult dragonflies.

Plate XLIV is a good view of this very interesting lake. The photograph was made from the bridge at the outlet. The view is northeast, up the lake. In the foreground is a bed of pond lilies. Rushes almost choke the stream. The dense vegetation along the shore line is plainly discernible. The wooded valley is a great shelter for white-tailed deer. During ten days stay in the region not a day passed without some one of the party either seeing or hearing an animal. Bear are abundant in the hills.

In the hills east of the lake mountain goats are reported. In former years an occasional moose is said to have reached this region, though none are now seen. Their spoor is found in the mountains shown in the background. Elk and black-tailed or mule deer were also formerly taken in this region. The former are no longer seen, and the latter only occasionally. But the white-tailed or Virginia deer roams the forests in the summer from the settlements to the summits of the range. altitude 7,500 feet. They have been seen on the snow banks almost at the summits. They are fond of lying in the open places on the high ridges in summer. Here they escape in part from their worst enemies, the flies. Food is abundant. They bask in the sun, rarely disturbed by man.

It was stated that the borders of Rost lake contained many sphagnum bogs, mud holes and swamps. In July we traveled miles of meadows and bogs with scarcely a dry knoll during the entire distance. In these marshes, which are no doubt deep in early spring, there must be an abundance of smaller life.

Among the interesting features presented by a brief stay at this lake was the information that all the deer were badly infested by a liver fluke. Numerous reports came regarding the "bloodsuckers" that were in the liver of every deer, etc. Coming from reliable sources these stories could not be denied. The first specimen examined after hearing these reports had two large flukes encysted in the liver. Old residents make the statement that "when you kill a big old buck in the fall, take out his liver and shake it, it is so rotten with bloodsuckers it falls to pieces." The life history of this fluke will be an interesting study for some one. From the shells thus far found the early stages are likely to be in a *Physa*, although *Planorbis trivolvis* should be present in the region.

Next to *Daphnia* pond Rost lake has greatest interest for students at the Biological Station.

Echo Lake.

This interesting lake lies close to the Swan range of the Kootenai mountains, between the Swan range and Flathead river. It is but eight or nine miles from the Biological Station.

The outline of the lake is very irregular. From the mountain tops the outline very much resembles the letter H, with small projections in different directions. This may be studied from examination of Plate XXXVII. The total shore line of the lake, including all the arms, is said to be from 12 to 14 miles. The width varies from a half mile to a narrow neck.

Its depth is said to be great at the eastern arm, the head of the lake, but the soundings showed less than 20 feet.

The lake has no surface outlet. The waters are held in by glacial deposit, evidently a portion of a moraine. The waters escape through an underground outlet, finally reaching Flathead river, though just where the outlet is or how far it extends underground is not yet known.

Very recent, or present connection with some large body of water is indicated by the presence of at least four species of fish, the squawfish, *Ptychocheilus oregonensis*, Rich., whitefish, *Coregonus williamsoni*, Girard, minnow, *Leuciscus*, probably gilli, and trout, *Salmo mykiss*. It is said to have suckers, *Catostomus*, also. A very large spring is reported a short distance from the lake on the west, but it has not yet been examined.

The lake has an annual rise of from five to seven feet, the waters filling up with the melting of snow in the spring and summer, reaching the low stage again late in the fall or early in the winter. The drainage is from a small portion of the west slope of the Swan range, and a small portion of the timbered valley adjacent to the waters of the lake.

The lake lies in a trough or depression in the wooded valley. Its banks are steep slopes, leading up to the valley plain, densely wooded with fir, tamarack, lodgepole pine, yellow pine, and an occasional white pine. Maple, alder, cottonwood and birch are present, but less numerous.

In the year 1894 the surface of the lake rose during the freshet to a point some ten or twelve feet above its usual height, and has remained so ever since. This elevation of water surface, and consequent submergence of land, appears to be due not to the submergence by sinking of land surface, but to filling up the underground outlet, preventing the water from escaping. This additional depth of water has drowned considerable vegetation, and in one case has submerged a meadow of several acres, including house, barn, and fences, the lake water covering to a depth of several feet what was formerly a meadow and garden. The old house at present has the water half way up the door, whereas previous to the rise it was on the bank of a creek emptying into the lake. What was formerly the mouth of the creek, and for a quarter of a mile back, is now a part of the lake. This is plainly shown in Plate XLII. The bridge in the illustration formerly spanned the creek. The water is new lake.

This photograph was taken during the summer of 1901. In 1902 a

visit to the lake at the same place shows that the water has risen several feet higher in the lake, to the eaves of the log house in Plate XLII.

This seems to prove the statement made relative to the closure of the underground channel. If the lake continues to rise from year to year the results may be disastrous, as it may overflow the bank at some point, doing much damage.

Echo lake has not received extensive study, and offers a very promising field for a summer's work for some one who wishes to undertake it.

There are morainal hills a hundred feet or more in height between the lake and Flathead river. Ranchers, in digging wells, pass through alternate layers of sand and gravel containing water. The indications point to the existence of this sand and gravel from Echo lake to or near to Flathead river.

The canyons in the mountain sides to the east of Echo lake show distinct evidences of glaciation, leading from the slopes down into the valley. These various smaller glaciers from the west side of the Swan range and from the east side of the Mission range merged into one large glacier, which must have pushed down (northward) the Swan river valley. In Plate XXXVII the movement would be from left to right. At the same time a much larger ice mass was moving down the valley of the Flathead river and across Flathead lake. Evidences of this ice mass exist about Kalispell, along the shores of Flathead lake, and in the Mission valley to the south of Flathead lake. At the foot of Flathead lake the large and distinct moraine stretches from the Mission mountains on the east across the end of the lake to the Cabinets on the west, decreasing toward the west, and cut by the outlet of Flathead lake. As the ice river from Swan river valley moved northward it was met, almost at right angles, by the larger ice sheet covering the Flathead valley. The place of meeting should be the valley shown in the middle of Plate XXXVII.

The Mission range ends as such in the low hills south and west of Echo lake, in the immediate vicinity of the Biological laboratory. These hills may be seen in Plate XXXVII to the left and immediately in front of Flathead lake. This northern end shows distinct evidences of glacial tation. Large boulders, with abundant and deep striations lie at or near the summits.

The contour of the land indicates that Swan river formely had its course northward, instead of turning to the west as is now the case. When the river and valley were filled with ice, meeting the larger ice mass, the larger mass caused a deflection of the smaller (Swan river valley) mass causing it to pile upon and flow over the lower slopes of the Mission range. This deflection probably aided in carving the present channel of Swan river, where it makes an abrupt turn and passes through a short and steep descent to the lake.

The retreat of the main ice sheet was probably more rapid than that of the Swan river valley mass, owing to the close proximity of mountain ranges feeding the latter. The result was a morainal deposit at what should be the surface outlet and what is the underground outlet, of Echo lake. Echo lake therefore appears to be either a portion of the old river bed, or a depression left in the morainal mass by the retreat of the ice.

It seems very probable that the Swan river formerly flowed north along the base of the Swan range on the west, emptying into Flathead river north of Columbia Falls. The evidence for this is as follows. Between Rost lake and Swan river, a distance of but a little over a mile, the surface is low, level, boggy, and swampy. The impression is that the soil is the recently uncovered bottom of a quiet lake. Rost lake has been described. North of this lake for several miles the surface alternates with open and wet meadows, boggy woods, and swamps that partially dry in summer. This condition seems to prevail north to the end of the Swan range. Pasing from the mountains westward at Rost lake the surface is as follows: First are the timbered slopes immediately west of the range; next is the mud bottomed lake with its swampy border; then come the open woods on higher and drier morainal sandy soil; further west is the low end of the Mission range, rounded by ice; beyond is the valley of the Flathead river.

North of this line just drawn the swamp region takes the place of Rost lake, widening so as to include Echo lake and territory east of it. Further north the end of the Mission range disappears, blending with the morainal drift, which lies continuous with the Mission and parallel with the Swan range. The low and wet belt, narrowing to a small strip, lies between the morainal ridges and the mountains. The only explanation to be offered for this conspicuously low and swampy region is that it is the remnant of the old stream.

Adopting this view as a basis for argument it would appear that the river formerly flowed north as previously indicated. In the Rost lake region it probably widened into a lake with swampy bottom.

I have no opinion as yet concerning the manner of closing the channel so as to turn the river westward. The great bend made by the water as it flows north from Swan lake, then west, south and again west seems to indicate a dam by ice, possibly an unusual ice flow from the region of MacDougal peak, where remnants of glaciers still remain. In event of such an ice dam, which may have occurred farther north than the point suggested, even to Flathead river, the waters from the west side of the Swan and east side of the Mission ranges would be imprisoned, damming up far beyond the present head of Swan lake. The elevation necessary in order to overflow westward across the end of the Mission range is not determined, but it is not great. The water began cutting through the low gap. The cutting was rapid. The water meandered over the wide level valley left comparatively dry, seeking escape, finally making the present tortuous channel.

The lake is a place of great interest to a biologist. Having no surface outlet its animal life presents many striking peculiarities. In its waters was found a new hydra, *Hydra corala* Elrod and Ricker, elsewhere described. In the same locality where the hydra was collected was found a species of *Polygnum* which has been growing in shallow water since the rise of the lake, before that being undoubtedly on dry meadow banks. This plant has accommodated itself to its new surroundings, and adapted its structure to the new conditions. The joints are swollen to considerable proportions, conspicuously noticeable. The lake contains an abundance of entomostracan life.

Swan Lake.

From Swan lake to the Mission mountains westward the distance is perhaps not more than six miles. It lies in a direction north and south, parallel with Flathead lake. It was evidently formed by the same geological method, faulting, the western half of the uplift of the Swan range falling after the upheaval, thus making the valley between the Swan and mission ranges, in which Swan lake lies.

From the laboratory at the outlet of Swan river to Swan lake is perhaps eight miles. The road winds through the forests and along the river, mostly through unfenced country, scarcely touched by the hand of man. There are a few houses along the road, several more between the road and the mountains to the west. The timber close to the road is mostly lodge pole pine, *Pinus Murrayana*, Engl., and Douglas spruce, *Pseudotsuga mucronata*, Raf. Occasionally in the smaller timber there rises the tall trunk of a monster tamarack or yellow pine, showing that in days gone by a different forest growth covered the country. Towards the Mission range there is considerable low and swampy land, apparently the remains of a portion of the old lake before mentioned, where is to be found an abundant growth of arbor-vitae, or white cedar, *Thuja plicata*, Don. Some of the mountain spurs have a dense growth of young timber of this species, so thick that the sun scarcely strikes the ground through the foliage, and where underbrush and other vegetation are entirely wanting. In passing through such timber one is continually squeezing between small trunks, often no thicker than one's arm, breaking limbs to make a passage, with nothing but dead leaves underfoot. It is impossible to see out in any direction. One must follow the compass, not knowing whether before there is a lake, a swamp, a steep slope, or open woods.

While exploring a portion of this region we came upon some blazes on the trees. At first these were supposed to be the marks of the surveyors. The compass showed them to be out of line with the directions which surveyors would take, and the question then was as to what the blazes would mean. It was decided to follow them up the mountain side, through the dense timber. The way wandered much through the woods, apparently taking an uncertain direction. They were certainly made by some one who was undecided as to his bearings. They finally led up the mountain side to a tree well cut, barked almost around the trunk. From indications it was decided that some hunter a few years before had killed an animal at this spot, and had blazed his way out in order to be able to return for his game.

On this same trip, leaving the blazed trail before mentioned, we took the direction of the compass southeast, wishing to come out at a lake reported to lie between the river and the Mission mountains, a little north of Swan lake. The timber was very thick, and a view impossible. Following down a ridge which we had been ascending for some time, we came in sight of a small lake, covering but a few acres, lying in a pocket between two steep slopes. As we descended to the lake shore a pair of

golden-eye ducks started in affright. A kingfisher noisily resented our intrusion, perhaps the first for a long time. A flicker called from a nearby tree, and drummed loudly. Otherwise the woods seemed to be silent. The lake was almost choked by hydrophytic vegetation. The waters were of a beautiful blue color, causing exclamations of surprise and delight. We were not prepared to make examination of the water.

The ridge proved to be morainal, as shown by the rounded pebbles and stranded boulders on the surface. It continues to the lake, as we afterwards discovered, cutting the lake in twain, really making the lake double. This body of water is perhaps a mile or more across, somewhat elliptical in outline, timbered to the edge, and unexplored. The ridge cutting the lake in two meets the waters of the lake approximately at the middle, extending from side to side of the lake. The morainal ridge extends almost due east and west. The ridge is sharp and steep, and at the same time narrow. On the summit the distance across is but a few feet. In height it is perhaps a hundred feet above the water. It is well wooded with small timber. On the north the trees are arbor-vitae, on the south Douglas spruce. It is a place where the sharpest line yet observed is drawn between forest growth of two different species, showing plainly how slight differences in location may make sufficient difference to give one species an advantage over the other. The southern side of the sharp ridge faces the sun, is dry, and supports Douglas spruce. The north slope holds more moisture, gets much less sun, better suited to the growth of cedar.

A portion of this lake to the north has receded so as to uncover the ground, leaving a marshy meadow on which native hay grows in abundance. This is cut by thrifty ranchers for winter use. The lake is not named, is little known, and biologically is unexplored. As our trip on this occasion was hasty and merely for preliminary purposes no attempt was made to collect material. Indeed, it was late when we returned home from this hasty reconnoissance, much as we desired to make more careful examination. That must be left for future years.

On the ridge between the two portions of the lake a place was noticed where the grass and other vegetation was apparently trampled and mashed down as though a conflict had taken place. At first it was taken for the bed of a deer, but there was a marked difference in appearance between this and the ordinary deer bed. Examination disclosed the wasted skeleton of a porcupine, yet covered by portions of skin, and abundantly protected by long quills. The fight had taken place at the foot of a fir tree. Evidently the porcupine had just descended from the tree, when he was seized by an enemy, probably a wolf.

Along the bank of the old lake referred to as meadow was found the partly decayed skeleton of a fine white-tailed buck. He had a large pair of antlers, which were still covered with velvet. His death can only be conjectured, but must no doubt be referred to the hunter. Unfortunately his antlers were badly eaten by rodents, hence they were useless. On the border of the meadow a fine buck was roused from his midday slumbers. The timber was dense, and the first bound put him behind such a mass of tree trunks as to make a shot impossible. Up in

the woods we came across the fresh spoor of a bear. An old beaver dam separated the meadow into two portions. On the return we flushed three flocks of ruffed grouse, each containing a half dozen or more birds. It is apparently a good game region.

Swan lake is a beautiful sheet of water. It is but the widening of the river, the remnants of much larger lake, both at the upper and lower ends. It is estimated to be twelve miles long, but this estimate is probably a mile or more in excess of the true length. It is narrow except at the upper end. Here it broadens, making a circular bay perhaps three miles wide. Soundings have been taken at the lower end, and to a point about half way up. The deepest sounding taken was about eighty feet. At the lower end it is narrow, shallow, and with considerable current.

Above the bay mentioned is a large swampy area, the home of water fowl and aquatic insects. This swamp covers several square miles. At the lake it is densely covered with hydrophytic vegetation, making a dense growth to the height of a man's head. To collect in this region is to wade in water waist deep. It is practically impossible to use a boat, and when a bird is shot it may be irretrievably lost though but a short distance away. As one moves farther south from the lake the swamp vegetation becomes less profuse, finally yielding to grassy meadows. Bordering this the forest makes a shelter for wild game. Through this swamp Spring creek winds its way to the lake. Its outlet is choked by masses of yellow water lilies, floating potamogetons, and great tufts of water crowfoot. It is a very suitable place for fresh water invertebrates. At the outlet of the creek fishing is usually good, and rarely does the visitor push up the creek in a boat at eventide without sight of a deer.

Swan river enters the lake along the slope of the Mission range to the west. It does not empty into the upper end of the lake, but follows parallel to it for a mile or more, meeting the lake far down the bay. The river is a great fishing resort, and is much visited by fishermen and hunters. Many interesting regions are reported along its shores which the writer has not visited.

The shores of the lake are densely wooded. This timber extends up the slopes of both ranges to the rocky nummits. The mountains are not high, not exceeding 7,500 feet, and support timber to the rock crests. The timber is that prevailing in the region, the same species as mentioned for the region adjacent to Rost lake, one species prevailing in one locality, another most abundant at some other place. Most of the timber is of younger growth. The mountain slopes on either side of the lake are well wooded. Indeed, we may say they are densely wooded. The summits on the west are rounded, with no sharp peaks. These begin further to the south. The slope of the Swan range to the west is the more abrupt, since it is the cliff side of the fault. Weathering has reduced the range very much. Ice has no doubt had a great effect in breaking down the sharp ridges. At the upper end there is a small valley between the lake and the base of the mountain. This is very wet, covered with dense forest. Toward the middle and lower portion the hills end at the water's edge, clothed with timber to the base.

The wagon road from the north ends at the outlet of the lake. If one wishes to go farther he must proceed by boat, on foot, or with pack horse. The trail follows the east shore. It is well travelled, and is the only passageway from this region south to the headwaters of Swan river. The trail is kept open by the forest rangers. One may follow it to the headwaters, when it meets a wagon road. This may be followed to the Big Blackfoot river, thence to Missoula.

The upper half of Swan lake, the swamp at the upper end, and the Swan river region mentioned above, lie in the Lewis and Clarke forest reserve. The large timbered area included is therefore under the care of the government, and very little cutting has been done. There are several cabins along the shore of the lake, occupied by hardy pioneers who occupied the land before the Forest Reserve act was made. As a consequence there is little traffic on the lake. The boats are confined to a few row boats owned by different individuals.

During the summer of 1902 a party of thirty-one was taken across the lake to the upper end. A stay of several days was made in scientific work. This party taxed the facilities of the region. All the available boats on the lake were in use, as well as the canvas boat.

On this occasion an ascent was made of Hall's peak. This is a small and rugged rock pile rising out of a wooded slope with three separate humps or shoulders. The altitude is about 7,250. The summit is a sharp ridge, in several places barely wide enough to set foot for passage. On either side it is precipitous. When the rocks are bare of snow the peak is neither difficult nor dangerous to climb. It is necessary to skirt several places where the slope is very steep. With snow there would be no footing. When the surface is bare there is little trouble. It would probably be impossible to ascend this summit when it is covered with snow. Those who have reached it at such times report that they would not attempt the feat. There were a few snow patches below the summit at the time of our ascent, the last week in July. The view was very fine. The air was comparatively clear. Clouds gathered and indicated a rainy descent, but happily there was no rain. Among the party was Miss Pearl Ricker, of Des Moines, who is the first and at this writing the only woman to ascend this mountain.

The mountain is wooded to the very summit, save where the rocks have not disintegrated sufficiently to permit trees to grow. The few stunted and gnarled alpine firs and white-bark pines were small, and showed the great struggle they were making for an existence. Near the summit there was great profusion of spring flowers.

This peak stands out alone from the others in the range. It is connected eastward by a ridge a thousand feet below the summit. Deep and precipitous canyons separates it from the mountains on the north and south.

The mountain is not difficult of ascent, and the climb is devoid of interest until the last 1,200 feet are reached. A trail leads from Bond's cabin to the foot of the mountain. The climb is through dense timber, up a wide mountain face where directions are difficult to follow without the use of compass. There is no view in any directions save an occa-

sional glimpse of the lake until the foot of the cliffs at the summit is reached. From this up the view is superb.

The most impressive feature of the panorama spread before the eye is the great stretch of timbered country visible. Westward to the summit of the Mission range there is nothing to be seen of the mountains, so well are they hidden by the forests of pine, fir, and tamarack. The lake with its swamp and meadow relieves the somewhat monotonous view of forest, and sparkles and glistens in comparison with the sombre green of the trees. It looks beautiful in the valley far below. To the south is the timber belt along the Swan river. Pathless save for the trail mentioned, unbroken by the woodman's ax save for the few trees cut by the early settlers along the lake shore, it stretches as far as the eye can reach, and dimly beyond may be seen the high snow crowned summits marking the valley yet almost unknown. On the right may be seen the high summits of the Mission range, McDonald being most conspicuous. To the left Swan peak rises high towards the clouds, and in late summer wears a crown of white. Eastward the lower summits hide the wooded valley of the South fork. Everywhere forests greet the eye. No one can comprehend the enormous quantities of marketable timber visible from the summit of this mountain, almost all of which is in the forest reserve.

While the ascent is largely devoid of interest it is certainly worth while to see this great stretch of timbered country, and few are likely to make the ascent and be disappointed with the view.

The ornithology of the lake has been partially studied by Mr. Silloway, who has a special report on the birds of the region. This will be issued separately later. Mr. Whitford has made a comprehensive study of the forest region about the lake. He has travelled through many miles of pathless woods guided by the compass. Several weeks have been spent in this work. The result will be of great value to students of the laboratory, and to students of forestry in general. His report will no doubt be published in full by the Bureau of Forestry.

It would be premature to make report of the entomotraca in the lake. The material consists of collections made during two different summers. In 1900 the writer spent several days at the lake. Pumpings were made from different depths, and a number of surface hauls made. In 1902 Mr. Silloway made almost daily collections during the month of June. The work of Forbes has been previously referred to.

Shell life in the lake seems to be scarce. No more than six species have been found in the water or along shore. They are as follows:

Planorbis trivolvis Say. At the lower end they seemed rather common. At the upper end, in the swamp, Mr. Silloway secured a good series, and reported them abundant.

Limnaea stagnalis, L. A few specimens of this large shell were picked up at the lower end. At the upper end they were common in the swampy bay, where Mr. Silloway gathered a moderate quantity.

Limnaea emarginata, Say. Specimens very closely related to those found at McDonald lake, described as variety *montana*, were taken sparingly.

Physa heterostropha, Say. A few were picked up along shore at the

lower end. They were all dead, and no doubt were washed in from the nearby marshes.

Sphaerium partumeium, Say. A single dead specimen was taken along shore at the lower end. The statement made for the preceding species will no doubt apply to this.

Pyramidula strigosa var. *cooperi*, W. G. B. This land species was taken abundantly by Mr. Silloway, who reported it in great quantities during the wet month of June. It is interesting to note that it does not seem to be mixed with *P. solitaria*, so abundant on the opposite side of the Mission range.

The annual rise and fall of the lake does not seem to be more than a few feet. The area drained is almost entirely wooded. The snow is therefore held back in spring by the timber, which prevents the sun from taking it off rapidly. The only water of any importance entering lake is the river, which enters the bay toward the upper end as previously mentioned. On the east one small creek and several rivulets carry a few second feet of water. There are no streams worth mentioning coming from the Mission range into the lake. The entire shore along the Swan range at the upper end is springy. A few inches below the surface at almost any point reveals cold water, seepage from the hills, no doubt. The amount of water brought to the lake from this source is not known. The river at the inlet and outlet have not as yet been measured, and the flow cannot therefore be given.

Air currents in the region of Swan lake are pronounced, and merit notice. Lying in a cradle between two mountain ranges, its surface must be stirred by every mountain breeze. As has been mentioned, the higher slopes of both ranges are south of the lake. In summer these higher summits contain the greater portion of snow, while the peaks nearer the lake are mostly bare, save on the north and east. During the day these rock summits become heated, the warm air rising as the rocks become more and more affected by the sun. A current of air is therefore put in motion up the lake. This is usually felt during the day in summer. At dusk, after the sun has set, the reverse takes place. The rocks along the mountain ranges which during the day have been warm now cool rapidly. The cool air is heavy, and flows down the mountain slopes toward the center of the valley. Down this it moves. As it crosses the lake from the upper to the lower end its movement may be followed by the ripples on the surface. Occasionally this is intensified by a breeze, which may be occasioned in the same manner by extremes of heat, but which probably has some other origin. The result is a strong wind, perhaps sufficient to be called a gale, which piles up the water at the narrow outlet into waves of much force for so small a body of water.

The lake is free from driftwood. The currents just mentioned no doubt carry all the drift down lake to the outlet. From this place it may easily pass down the river and on to Flathead lake.

From its beautiful location in the heart of the mountains Swan lake will no doubt become a resort for those who wish a rest from mental labors. It is primitively wild. Game abounds. The lake is large enough for extensive boating with small craft. The waters are clear

and cool. Fishing is good. Mountain climbing may be indulged in to almost any extent. The lower peaks near the lake may be scaled, or the mountaineer may go south a few miles and find summits reaching to 10,000 feet. The region is a botanist's paradise. In the swamp the entomologist will find a rich field. No doubt many new species await the collector. Artists may find ample scope for the brush, and the weary brain may find a haven of almost complete rest if such is desired.

The Swan Range of the Kootenai Mountains.

Several excursions have been made into the Swan range in different years. In 1901, Dr. MacDougal, Mr. Harris, Mr. Ricker, Mr. Silloway and the writer shouldered packs and started over the trail to Haystack. We passed along the south face of this about third way up, and northeast to Silloway mountain. The second day Mr. Ricker and Mr. Silloway returned to camp. The remaining three passed entirely around the head of Wolf creek, ascended Craig mountain, followed its long ridge to the northern end, and descended through the woods to camp the third day without mishap.

The trail thinned out and disappeared early in the day. The slope was steep. The blazing July sun on the south side of the mountain was blistering hot. The way was almost barred by dense growth of rock maple, alder, mountain ash, New Jersey tea and *Menziesii* scrub. This growth was bent downward by many heavy and sliding snows. In its effort to straighten the shrubby vegetation had become a tangled mass, exceedingly difficult to penetrate.

From nine in the morning, when this scrub growth was first encountered, until six in the evening we worried through this dense and tangled shrubbery. Excessive thirst drove us to a descent to the creek at this time, as our canteens were long since empty. After a cool and refreshing draught the brush was again entered. It was worse than ever. It was impossible to see more than a few feet ahead, and it was often necessary to crawl on hands and knees to get through. Most of the time the head man was poking his gun between bent bushes with one hand and with the other trying to force the stems apart so as to slip through. Of course the others followed. The lead man was soon tired out with the threshing round he received and was relieved by another, and so on. It was the most trying, soul stirring, temper distracting and abominable place the writer has ever had the bad fortune to be in. Guns, packs, and other paraphernalia made progress so slow as to be very disheartening. Some of the boys wanted to stop and sleep on the brush. But we pushed on. About nine in the evening we stopped on a large flat rock, fifty feet above the stream, and 1,600 feet below the ridge we hoped to reach by night. So tired were we that we threw ourselves down to rest without removing the packs. After a meal remembered not by the abundance or variety of food, but by the fact that it was very good, we crawled into our sleeping bags around the campfire for a night's rest.

The next morning we were off before half past six. The slope was steep, and smoothed annually by spring avalanches. We reached the ridge summit at 9, prospected the three ridges to the mountain, as also the lake. As stated, two of the party returned from here to camp. The other three followed the ridge southward, skirted *Actomys* on the west, passed over some rocky cliffs into the pass of faulted rock between *Actomys* and Craig, spending the night between huge snowbanks. Our

supper consisted of emergency rations only. It was very palatable and satisfying. After the meal I skinned a ground hog I had previously shot and buried the carcass in the snow to try the meat for breakfast.

Breakfast consisted of emergency rations and ground hog. The latter was so tough we had to chew it as we went to save time, and little of it could be eaten. Old woodchuck from alpine regions is not recommended as a palatable diet.

Passage across the rock ribbed pass was interesting. It was up and down the faulted rock, with a tendency upward. Wearily the ascent of Craig mountain was made. After a rest the ridge was followed until the descent to camp began in earnest. After entering the dense timber nothing could be seen beyond the immediate foreground. During the afternoon our noise interrupted a bear at his feast of berries. Of course he immediately decamped. We arrived at camp tired and hungry, late in the evening.

A few weeks later, in the middle of August, Dr. MacDougal and the writer, accompanied by an old trapper, made an expedition into the Swan range over Aeneas trail. This time we took a pack horse to carry our luggage. A week was spent in gathering material. As we were not familiar with the region some time was lost in getting into localities desired. Ample collections of plants were made. The trip brings back only pleasant memories of beautiful moonlight nights, camps in delightful spots, and other reminiscences of similar nature. Of course there was rain, and hail, and sleet, and slippery trail with poor footing, long and hard tramps with good load to carry, but all these are forgotten.

Necessity demanded that many of the peaks and lakes be named. When collections are made they must be located. This will be apparent. The following pages give some of the names applied and the reason for each. No excuse is offered for these. They are as appropriate as any, unless it be some local characteristic which would be especially noticeable.

From the laboratory to the base of the mountains eastward the distance is twelve to fourteen miles. There is a good wagon road to within three miles of the base of the range, but it is a few miles farther by this road than by the trail. Starting from the top of the hill at the bend of the river north of the laboratory one may take a well worn trail through the woods to Nigger Prairie, from there following the wagon road, going either to Shultz's cabin, the end of one road, or to Rost lake, the end of another road, or to Swan lake, where the road ends in that direction.

The ascent of MacDougal Peak is made from Shultz's cabin; the ascent of Silloway mountain, Craig mountain or Haystack is made from Rost lake. The mountains farther south in the range are reached from the Swan lake region.

From Shultz's cabin the old Aeneas trail leads to the summit of the ridge, passing through a notch in the ridge, then to the left along the east slope in a direction northeast, and on to the South Fork of Flathead river. The trail is well worn and easily followed. It is full of snow until July, and in the middle of August the trail is par-

tially buried by drifts. Camp may be made at the end of the wagon road at Schultz's where there is water and pasture.

From the lower end of Rost lake a trail leads through the timber to the mountain side, evidently a game and huckleberry trail. At the base of the mountain it thins out and finally disappears. The trail may be found by following the wagon road to the first house on the east side. Cross the little meadow toward the mountain and the trail may be seen leading off into the woods. When it forks take the right hand fork. The mountain slope has no trail. On the canyon side it is very bad going. The route up over the summit of Haystack is preferable to the trip up the canyon. Silloway peak is the bald mountain east of the first summit, which is Haystack. Craig mountain is across the canyon south from Haystack. *Arctomys* is next southeast of Silloway, connected with Silloway and Craig mountains by low passes.

By passing up the east side of the lake to the second cabin another trail may be found. This trail leads through the woods to the pass between the southern or pointed peak of Haystack and the next one north. Hopkins, and over or through this pass to Silloway peak.

At the upper end of Rost lake on the west is a cabin. From this center several trails lead out. The main trail leads into the timber north, and by blazes may be followed to Shultz's cabin, where the Aeneas or Blackfoot trail is to be taken. About fifteen minutes walk after leaving the cabin brings one to a fork with a branch trail leading to the right. This branch goes to a series of bear traps. Farther on a branch to the left takes one up to the very foot of Haystack to trapper's cabin. By consulting Fig. 3, page 148, the above details may be easily made out.

At the foot of Swan lake if one has a wagon and wishes to go farther he must leave it. A well worn trail for pack horses may be followed up the east side of the lake. Or one may take a boat up the lake about twelve miles and then take the trail. This trail is kept open by forest rangers, and leads up Swan river to the divide between it and the Big Blackfoot, and down this to any point along the river.

In winter when the snow is deep and snowshoes are used the passage to the South Fork country is up Fulton creek and through the low pass between MacDougal peak and Estey. This pass is shown in the foreground of Plate XXXI, and is known as the Snow Shoe pass and trail. It is impracticable in the summer time on account of the dense brush.

The trails mentioned above are from the writer's personal knowledge. By consulting the pages elsewhere trails into the Mission range may be located.

The trail from Shultz's cabin to the foot of the mountain is well worn, and shows much usage. Up the mountain side it is tortuous, winding, and very irregular. It winds back and forth in the timber, unnecessarily increasing the distance, in some cases actually losing ascent as one proceeds upward. As one traveler on the trail expressed it, the trail gives the impression of having been made by a drunken squaw, who had no idea of where she was going, and who wandered around in the woods. But it is no easy matter to find a way through a densely tim-

bered region, with no view out, and to strike the main slope without more or less wandering is practically impossible, except when the view is open, which is rarely the case. But when the trail reaches the mountain slope and takes the ridge it goes directly up. The ascent is easy, but in several places quite steep. The first summit is at an altitude of 6,750 feet, approximately. This summit is the end of a spur from the main peak, connected with it by a long ridge. Between this summit and the main ridge farther east is a large amphitheater, wood mostly with black pine, and filled with snow until middle July. The trail follows the spur ridge for some distance, then drops off into the amphitheater and across to the notch in the ridge to the east, passing over much large and loose talus. It may be of value to travelers over the pass to know that just before making the steep ascent to the notch, in middle or late summer when the snow is gone, water may be had in abundance by following the dry water course down a few rods, where a large spring affords abundance of water. As this is the only water between the foot of the mountain at starting and the first lake beyond the notch its location in late summer is very important to mountain climbers.

Passing through the notch the trail thins out, and for a short distance is not easy to follow. It turns to the left. By following the base of the summit ridge it is not difficult to find it a few hundred yards ahead.

In ascending MacDougal peak the mountaineer does not follow the trail when it leaves the ridge before mentioned, although he may do so and later follow up the ridge from the notch. Instead the ridge is followed, until late in summer over snow banks. When the main ridge is reached, it is followed to the summit. On the eastern face of the ridge is an immense snow and ice mass which remains all summer, and which seems to have a little glacial movement. At the foot of the glacier is a small lake which is named Blue lake on account of the color of the water, which appears deep blue.

On the summit, altitude 7,725 is a U. S. G. S. triangulation stone monument. The view from this summit is superb, and the geology of the region may be studied to good advantage. Without duplicating descriptions the reader is referred to Plate XXXVII, which gives the view west and southwest, with explanations; to Plate XXXVIII, showing the backbone of the continent, the view being to the northeast. The mountain in the foreground is Dodge mountain, named in honor of Wm. E. Dodge, who has made large contributions toward the study of Montana flora; Plate XXXI shows the view to the southeast. Silloway peak is the double peak. Craig mountain is on the right. Silloway lake lies behind the double peak. Wolf creek takes its source in the depression seen between Silloway peak and Craig mountain.

In Plate XXXI four lakes are visible. In the foreground the larger one is MacDougal lake. The outlet is to the right, through Fulton creek.

On the summit of MacDougal peak were found large numbers of ladybird beetles, *Hippocampus 13-signata*, found on most of the summits with loose rock from Washington far east into Montana.

Dodge mountain has been traversed from end to end, and many rare botanical specimens secured.

Between Dodge mountain and Silloway peak is a deep canyon with steep sides. This is recognized as Wilson creek. On the northeastern side of Dodge mountain, low down, is a beautiful lake, Dodge lake. Between Dodge mountain and the slope leading down from MacDougal peak, northwest of Dodge mountain, is another lake, Sylvan lake. Its banks are abrupt on all sides except the outlet. In the wooded bench to the northeast of Sylvan lake may be found many smaller lakes, to which no names have been given.

From the notch before mentioned and from the crest of the ridge leading up to MacDougal peak a bench slopes off eastward. This is a beautiful park like slope, with a carpet of alpine flowers and beautiful though dwarfed trees. This is called Sylvan slope. The trail before mentioned traverses it for some distance, hugging the base of the ridges.

Sylvan slope is wooded by the same trees that grow on the higher summits. The two most abundant trees are the white-bark pine, *Pinus albicaulis* Engl., and the Alpine fir, *Abies lasiocarpa* Hook. In protected places these trees grow to a beautiful shape. They are usually limbed to the ground, the larger and longer limbs at the base. Succeeding limbs taper gradually to the summit or tip of the tree. The limbs are bent downward with the weight of snow during many winters. In most cases they make an acute angle with the trunk of the tree.

On the exposed slopes and summits the trees are torn and twisted, stunted and gnarled, almost limbless, with tops broken off, and roots exposed. They are subject to extremes of heat and cold, moisture and drouth.

Strong gales from different directions sweep the summits and ridges. The winds blow with fury. They turn and twist the trunks until they are misshapen and unsightly. But still the trees survive. Their mangled limbs and broken trunks are silent witnesses to the fierce struggle through which they have passed.

The contrast between the exposed and protected trees is very great, as may be seen by consulting the plates. Sylvan slope is an ideal region. To spend a night there is to have the feeling of perfect rest and peace. No one can forget the beautiful trees, the marked contrast between flowers and snow, water and sky, lakes and cliffs, roaring water falls and murmuring pines, barren rocks and mossy banks, or can blot from memory the magnificence of a night when the moon is at its full and the sky is clear.

There are many of these benches, made by faulting in the uplift, between the crest and the South Fork river. They are long, steep, and heavily timbered, enclosing many lakes, and holding large masses of snow. Sylvan lake is reached by passing down the slope eastward immediately after passing through the notch in the main ridge. It is yet unexplored zoologically.

The trail follows Sylvan slope for some distance, a couple of hours walk. Even in July and August there are large snow banks in the ravines along the slope. An admirable opportunity for study of alpine flora is presented in this field. The trail then drops abruptly over the ridges and down a very steep bank for more than a thousand feet to another beautiful lake. This we called Placid lake.

Placid lake is hemmed in on all sides by abrupt slopes, save toward the southeast, in which direction the small stream leaving the lake flows toward the South Fork river. At the upper end of the lake is a small and densely wooded flat. The trees are beautifully formed, tapering to a point, tall and stately. It is a fine place for camping, and game appears to be abundant in all the timbered slopes and valleys. The trail is traveled very rarely, and the life of the lake and adjacent territory is unknown, save from the collections made at the time of our visit, and which will be reported later. It appears that the Indians have made this a halting place in earlier days.

From Placid lake the trail ascends a ridge to the northeast, the ascent being about 800 feet. The view in every direction is very fine, and for this reason the ridge was named View ridge. At the time of our visit the vegetation was very luxuriant. A storm was approaching from the east, across the main Rockies, the backbone of the continent. Heavy clouds were rolling over the peaks, enveloping them one by one. It was a rare sight to stand at a distance and see the ranges slowly wrapped in a mantle of mist. Behind, almost a thousand feet below, was to be seen Placid lake. Beyond it was the main ridge of the Swan range; to the left was Dodge mountain, bold and rugged. Between View ridge and Dodge mountain is a creek of considerable size, unnamed. This creek we called Trail creek, because the old trail is not far from it during its entire course, and crosses the creek again before it flows into the South Fork river. Let us again follow the trail, down View ridge; between it and the next ridge is another beautiful lake, larger than Placid lake, and more interesting. The trail passes close by the lake. The shores of the lake have no doubt been the camping place of Indians, as evidenced by the large number of tepee poles. The age of these poles shows that they were used many years ago. Game signs are abundant. Collecting is good, but owing to lack of facilities the life of the lake was not examined. From this region many rare botanical specimens were secured.

Again the trail makes the ascent of a ridge, to the northeast. It follows the summit of the ridge southeastward, and keeps on the ridge until it drops off to the South Fork river. For this reason the ridge was named Trail ridge. The lake is likewise named Trail lake. The names Trail creek, Trail lake, and Trail ridge seem very appropriate. The waters from Trail lake flow in the opposite direction from those of Placid lake, and reach the South Fork river by an unknown and unexplored creek. The waters of Placid lake flow into Trail creek. Trail creek originates in the snow banks and glacier on MacDougal peak.

The view from Trail ridge is excelled only by that from View ridge, and the territory one may inspect is considerable. The ridges and valleys are well wooded, and to leave the ridge is to plunge into timber where a view of the surrounding country is seldom had.

Table of Altitudes.

The altitudes below are from aneroid readings. The barometer is of English make, compensated, reading to 20,000 feet. It has been thoroughly tested, and the readings, although uncorrected for atmospheric variations, are not far from correct. The altitudes are given for the benefit of those who may be traveling in the regions mentioned.

Kalispell, correct	2,946
Flathead Lake	2,916
Biological Station (approximate)	2,935
Rost Lake	3,200
Summit of Ridge on Silloway Peak, immediately above and west of Silloway Lake	7,350
Wolf Creek at base of preceding ridge	5,450
Silloway Peak, highest	7,725
Silloway Peak, second summit	7,625
Saddle, between Silloway and Arctomys	6,800
Pass at head of Wolf Creek	6,550
Craig Mountain, highest	7,425
Shultz's cabin	3,225
Water, trail above Shultz's	4,000
First Summit, MacDougal Peak	6,750
MacDougal Peak	7,725
Notch, where trail passes	7,075
Dodge Mountain	7,425
Sylvan Lake	6,450
Peak between MacDougal and Dodge	7,400
Placid Lake	5,950
Trail strikes View Ridge at	6,850
View Ridge, highest,	7,450
Trail lake	6,200
Trail strikes Trail Ridge at	6,750
Trail Ridge, summit	6,950
Sin-yale-a-min Lake	3,800
Sin-yale-a-min Mountain	9,250
McDonald Lake	3,300
McDonald Peak, west summit	9,500
Post Creek at wagon road	2,300
Summit of Moraine at Flathead Lake	3,400

MONTANA SHELLS.

The following list comprises the land and fresh water shells reported from the state. The list contains 60 species and varieties, 25 of which have been collected west of the main range of the Rocky Mountains, 42 east of the range. This makes a list of seven found on both sides of the Rocky mountains.

The collection east of the range was made largely by Homer Squyer, of Wibaux, recorded in *Nautilus*, Vol. VIII, pp. 63-65. At the time the record was made the town was called Mingusville, since changed to Wibaux. The shells from Madison Lakes and Tobacco Root Mountains were collected by Earl Douglas and E. H. Murray. Those on the western slope were all collected by the writer.

The list certainly does not represent the entire molluscan fauna of the state, and is given merely as a basis for work, so that those interested in these forms may be able to work intelligently. Residents of the state are invited to send to the writer shells from their localities, so as to aid in making a complete list.

Full information and notes regarding these shells are to be found in the articles mentioned in the appended Bibliography.

It will be observed that the shells collected are from extreme ends of the state, with a few only from the interior. As the state is about 600 miles long there is consequently an extensive area intervening between the two collecting fields which yet awaits study.

The writer is under many obligations to Dr. W. H. Dall, of the Smithsonian Institute, and Dr. H. A. Pilsbry, of the Philadelphia Academy of Science, for their valuable assistance, so freely and cheerfully given, in the determination of specimens.

PHYLUM MOLLUSCA.

Class LAMELLIBRANCHIATA.

Order Siphonata.

Family CYCLADIDAE.

Genus *Sphaerium*.

Sphaerium sulcatum Lam.; Wibaux.

Sphaerium partumeium Say; Daphnia Pond, Swan Lake.

Genus *Pisidium*.

Pisidium compressum Prime; Wibaux.

Order Asiphonata.

Family UNIONIDAE.

Genus *Anodonta*.

Anodonta plana Lea; young, Wibaux.

Anodonta ovata Lea; young. Wibaux.

Genus *Margaritana*.

Margaritana margaritifera Lea; Bitter Root River. Tributaries of Pend d'Oreille River.

Class GASTROPODA.

Subclass Euthyneura.

Order Pulmonata.

Suborder Stylommatophora.

(Superfamily Holopoda.)

Family HELICIDAE.

Subfamily Helicinae (vel Belogona.)

Genus *Vallonia*, Risso, 1826.

Vallonia gracilicosta Reinh.; Wibaux.

Vallonia gracilicosta Reinh., var. close to *costata* Say; Wibaux.

Vallonia perspectiva Sterki; Wibaux.

Vallonia pulchella Mull.; Wibaux.

Subfamily Ploygyrinae (vel Protogna.)

Genus *Polygyra* Say, 1818.

Polygyra albolabris Say. A single specimen, which I refer to this species, was sent from Lewistown by P. M. Silloway, while the proof was being read.

Polygyra devia, var. *hemphilli* W. G. B.; Missoula.

Polygyra townsendiana, var. *ptycophora* A. D. Br.; Flathead Indian Reservation, in Mission Valley and Mission Mountains.

Family PUPIDAE.

Genus *Pupa* Draparnand.

Pupa muscorum L.; Wibaux.

Pupa blandi Morse; Wibaux.

Pupa blandi Morse, var. *edentata*; one specimen, Wibaux.

Pupa syngenes Pilsbry; eight more or less perfect specimens, Wibaux.

Pupa holzingeri Sterki; Wibaux.

Pupa armifera Say; Wibaux.

Pupa pentodon Say; Wibaux.

Pupa decora Gld; Wibaux.

Genus *Vertigo* Draparnand.

Vertigo ovata Say; Wibaux.

Vertigo binneyana Sterki; Wibaux.

(Superfamily AULACAPODA Pilsbry.)

Family ZONITIDAE.

Subfamily Zonitinae Pilsbry.

Genus *Vitrea* Fitzinger.

Vitrea arborea Say; worn var., approaching *V. breweri* Newb. Wibaux.

Vitrea radiatula Alder; rare. Wibaux.

Genus *Conulus* Fitzinger, 1833.

Conulus fulvus Mull.: one specimen from Wibaux; a few from Missoula.

Subfamily *Ariophantinae* Pilsbry.

Genus *Zonitoides* Lehmann, 1862.

Zonitoides minusculus Binn.; Wibaux.

Zonitoides laeviusculus Sterki; close to vars. of *minuscule*; Wibaux.

Zonitoides conspectus Bland; Wibaux.

Zonitoides arboreus Say; sparingly along the Bitter Root River.

Family LIMACIDAE.

Genus *Agriolimax* Moersch, 1868.

Agriolimax campestris Binn., var. *montanus* Ing.; Missoula, Flathead Lake.

Family ENDODONTIDAE.

Subfamily *Endontinae* Pils.

Genus *Pyramidula* Fitzinger, 1833.

Subgenus *Patula* Held, 1837.

Pyramidula elrodi Pils.; Banks of McDonald Lake, Mission Mountains from 3,000 to 7,500 feet.

Pyramidula strigosa Gld.; Tobacco Root Mountains, Bitter Root Mountains.

Pyramidula strigosa Gld.; var. *cooperi* W. G. B.; Mission Mountains, banks of Flathead Lake, Swan range of the Kootenai Mountains.

Pyramidula strigosa Gld., var. *alpina*; Mission Mountains above 7,800 feet altitude.

Pyramidula solitaria Say.; Missoula; Mission Mountains from 2,300 to 7,500 feet.

Subgenus *Gonyodiscus* Fitz.

Pyramidula striatella Anth.; Wibaux; a few from Missoula.

(Superfamily ELASMOGNATHA.)

Family SUCCINEIDAE.

Genus *Succinea* Drap.

(Amphibinae.)

Succinea avara Say; Wibaux.

Succinea obliqua Say; Wibaux.

Succinea grosvenorii Lea; Wibaux.

Succinea nuttalliana Lea; Flathead Lake.

Family LIMNAEIDAE.

Genus *Limnaea*.

Limnaea palustris Mull.; Wibaux, Flathead Lake, Swan Lake, Madison Lakes, Missoula.

Limnaea bulimoides Lea; Wibaux.

Limnaea humilis Say; Wibaux.

Limnaea caperata Say; Wibaux.

Limnaea stagnalis L., var. *appressa* Say; Bitter Root River, Swan Lake.

Limnaea nuttalliana Lea; Missoula.

Limnaea emarginata Say, var. *montana* Elrod; Sinyaleamin Lake and McDonald Lake in the Mission Mountains, Swan Lake.

Genus *Planorbis*.

Planorbis bicarinatus Say; Wibaux.

Planorbis lentus? Say; young shells only, Wibaux.

Planorbis parvus Say; Wibaux, Flathead Lake.

Planorbis umbilicatellus Cockrell (*P. umbilicatus* Taylor); Wibaux.

Planorbis trivolvis L.; Daphnia Pond, Flathead Lake, Sinyaleamin Lake, Swan Lake.

Family **ANCYLIDAE**.

Ancylus rivularia Say; one specimen from Wibaux.

Family **PHYSIDAE**.

Genus *Physa*.

Physa gyrina Say; young only, Wibaux, Missoula.

Physa ancillaria Say; Wibaux.

Physa heterostropha Say; Wibaux, Missoula.

Physa lordi Baird; Wibaux.

Physa ampullacea Gld., lakes in the Mission Mountains, Flathead Lake, Swan Lake.

Genus *Aplexa*.

Aplexa hypnorum; ponds along the Missoula River near Missoula.

The five species following are referred to in Pilsbry and Johnson's Catalogue of the Land Shells of America as probably occurring in Montana. The notes accompanying are quoted from the catalogue. The addition of these to the preceding list makes the total number of species and varieties in the state 65.

Vallonia costata montana Sterki, Rocky Mountains.

Vallonia cyclophorella Ancey, Washington to Montana.

Polygyra devia mullani (Bld. and Coop.), near Coeur d'Alene Mission, Coeur d'Alene Mountains, Idaho; west side of Bitter Root Mountains, Washington.

Polygyrella polygyrella (Bld. and Coop.), Coeur d'Alene Mountains, Idaho. A variety *montanensis* Ancey is described from Deer Lodge Valley, Montana.

Succinea retusa Lea. Canada to Montana, southward to Georgia.

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ERRATA.

Page 119, fourth line from bottom, read bluebird for blubird.

Page 121, fifteenth line from top, read *alpina* for *montana*.

Page 149, twentieth line from top, read *Betula papyrifera* for *Betula papyfera*.

Page 163, twenty-first line from top, read Blackfeet for Blackfoot.

Page 122, second line from top, read Lace lake for Leash lake.

Page 147, ninth line from top, read *ponderosa* for *scopulorum*. At other places where reference is made to yellow pine *ponderosa* should be used instead of *scopulorum*.

Page 147, fourth paragraph from top. *Populus angustifolia* should read *Populus balsamifera* var. *candicans*. Dr. J. W. Blankinship of the Agricultural College expresses the opinion that this latter is the only species in the western part of the state.

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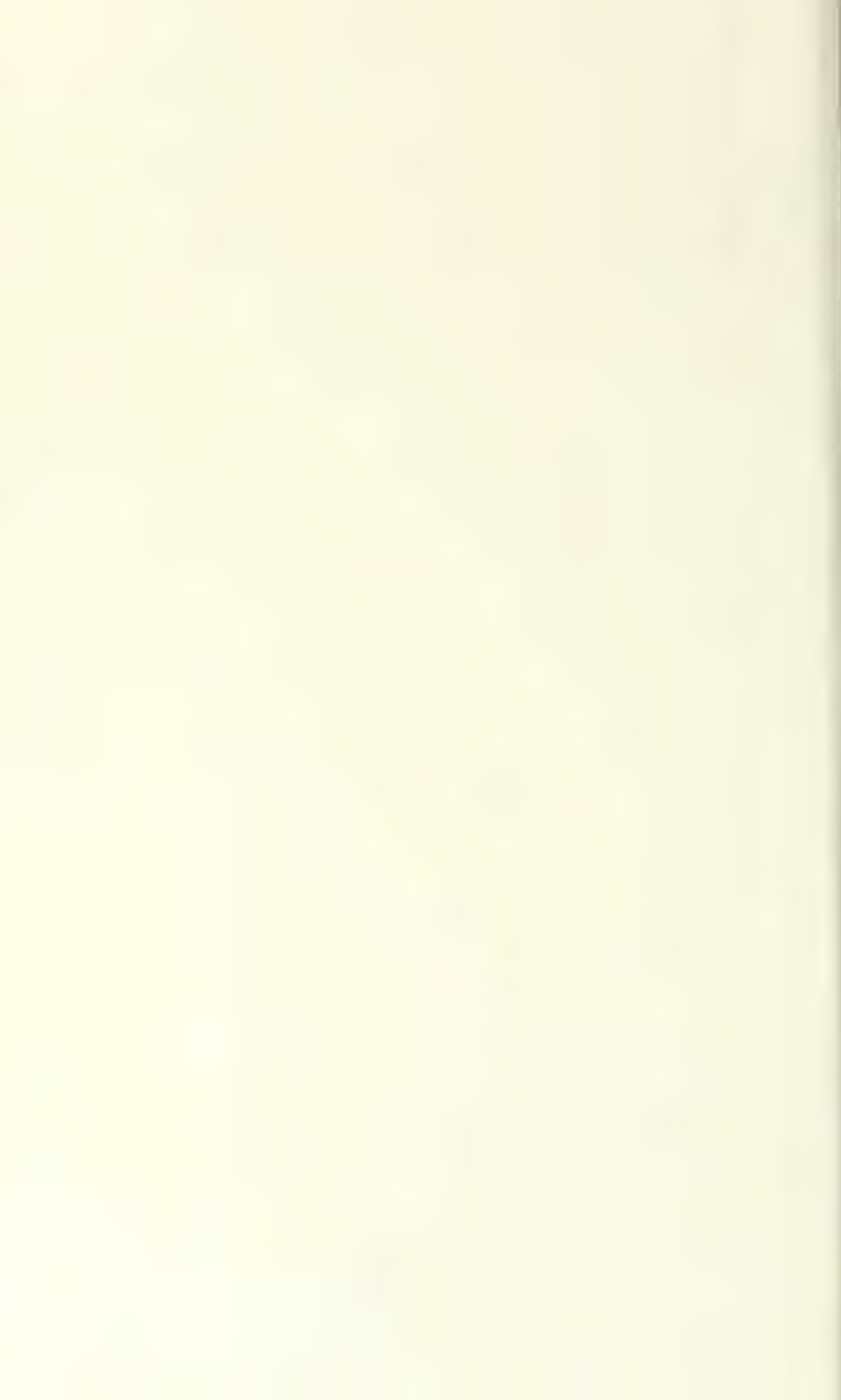
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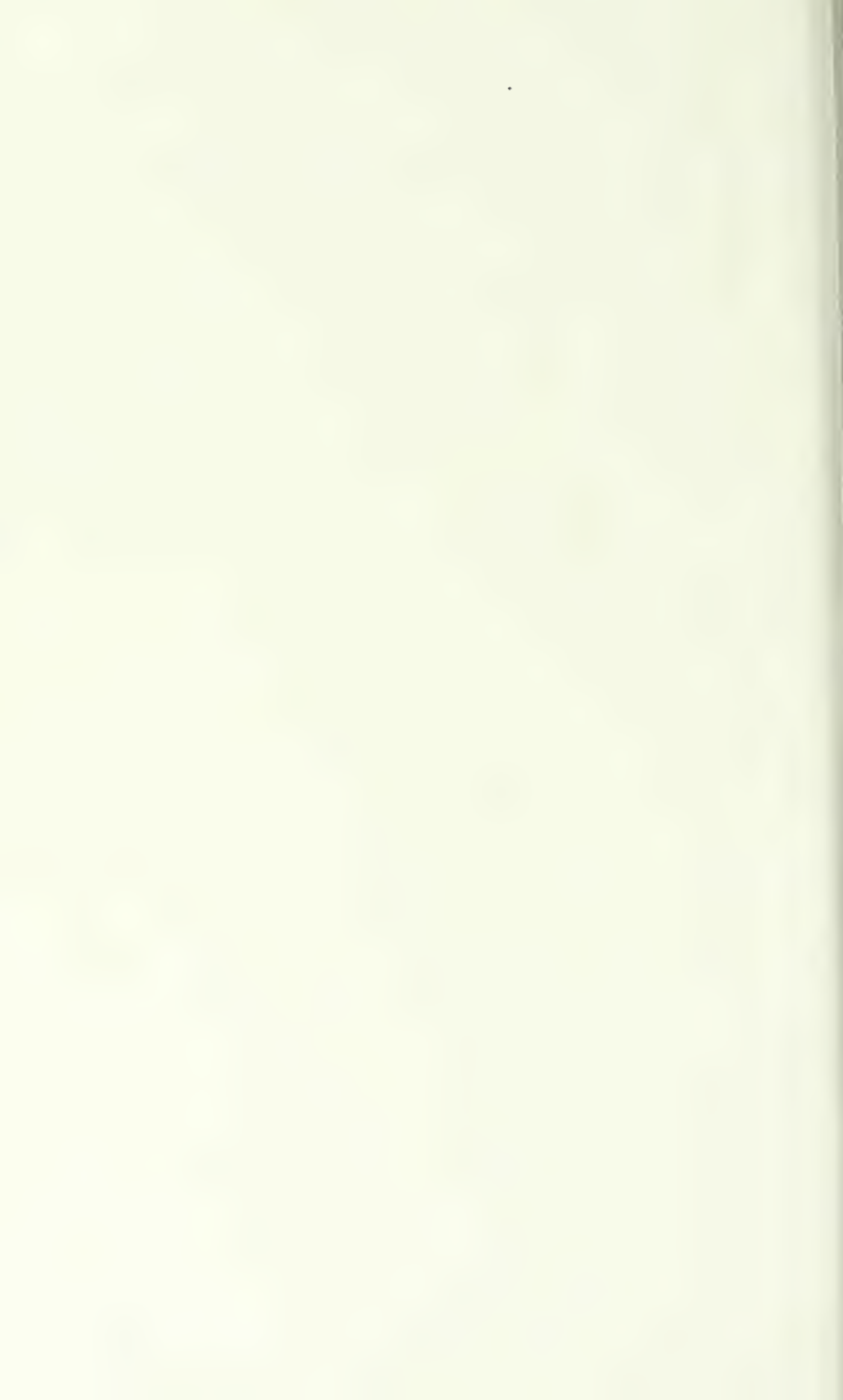


View of the southern end of the Mission Range from hill south of St. Ignatius, which is in the valley in the foreground. Mission Creek may be followed by the shrubbery growing along its banks. Photo by M. J. E.



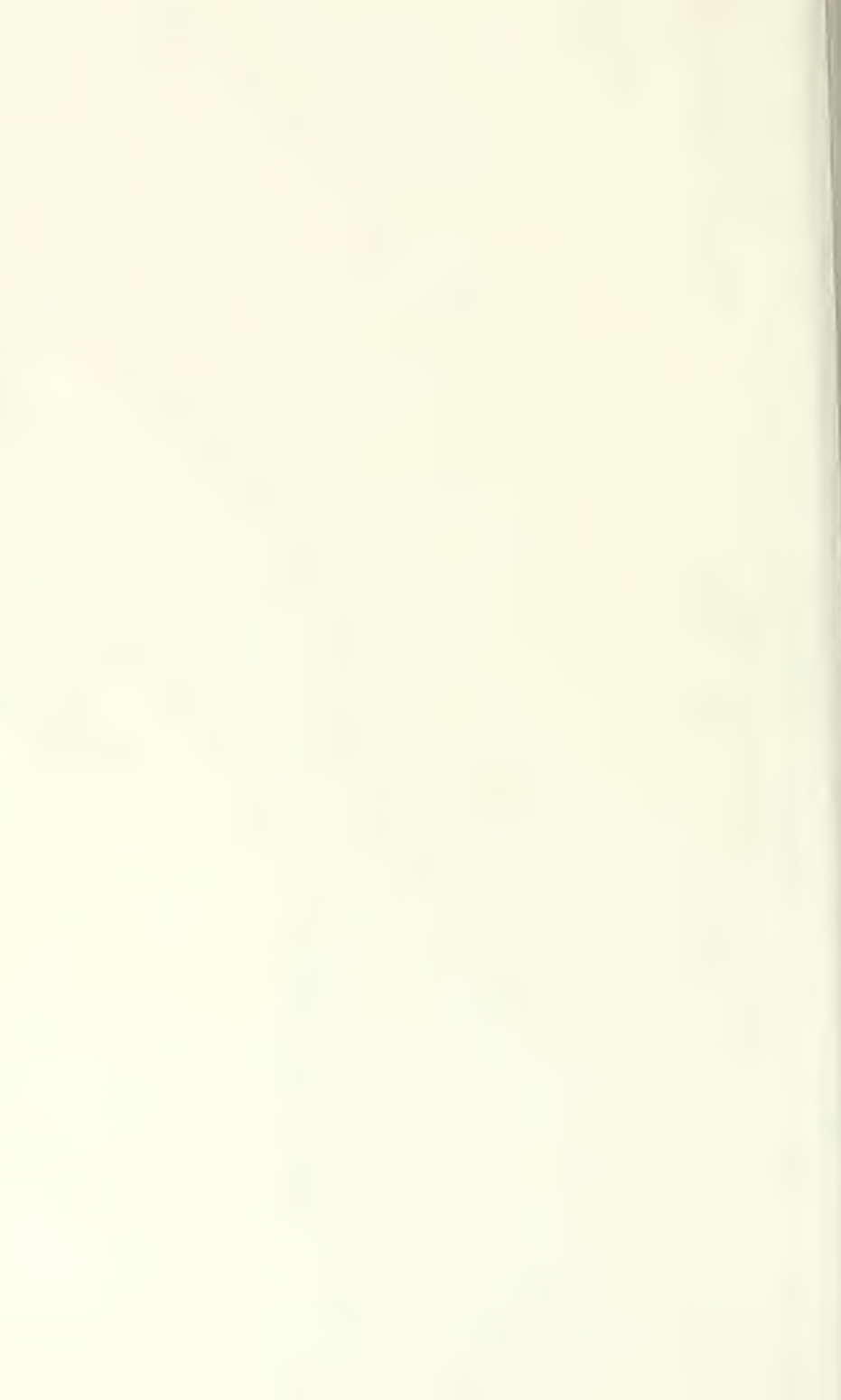


Siyahemini Mountain, from the south. Photo by Morton J. Erold. The view is north.





The Jocko Crag, seen from the summit of Sinyalemin Mountain. The view is east. Snow Lake lies at the base of the mountain on the right. Photo by M. J. Elrod, July, 1900.





Silloway Lake from Silloway Peak, showing a typical alpine lake, enclosed on all sides, and fed by snow. The view is southeast. Taken early in July. Photo by Maurice Ricker.



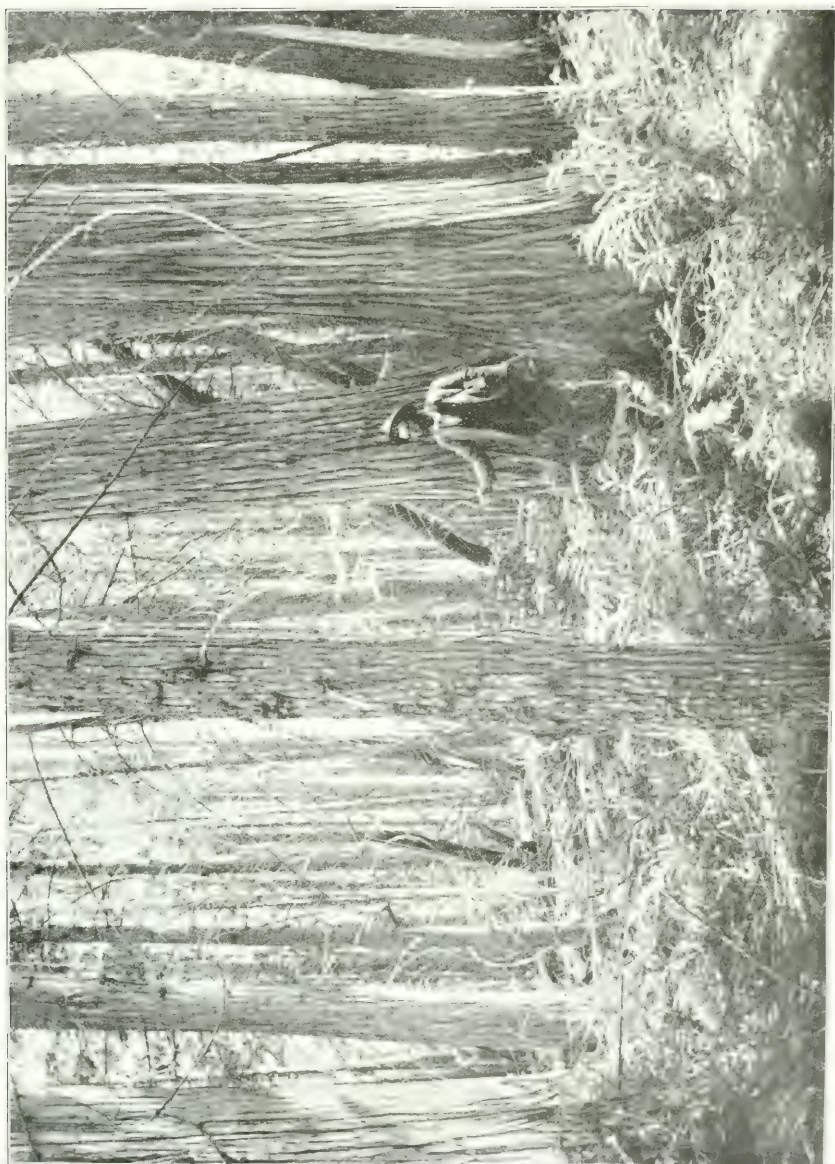


Sinyaleamin Lake, from the southern side. The camp site is across the lake. Sinyaleamin Mountain beyond.





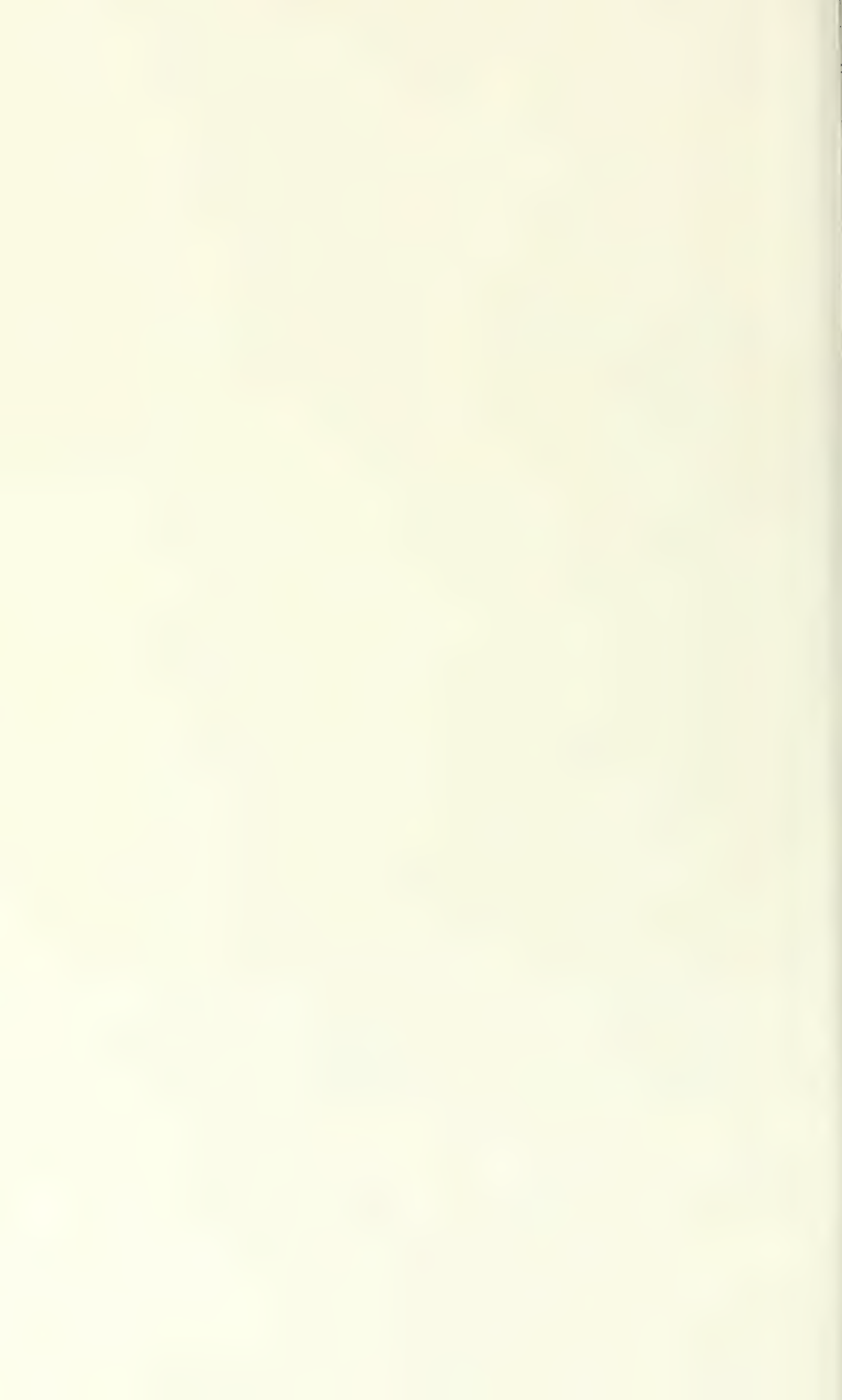
Pines on the slope of Sinyaleamin Mountain, at altitude of 7800 feet, showing the struggle they make for an existence. Photo by Prof. L. A. Youtz.

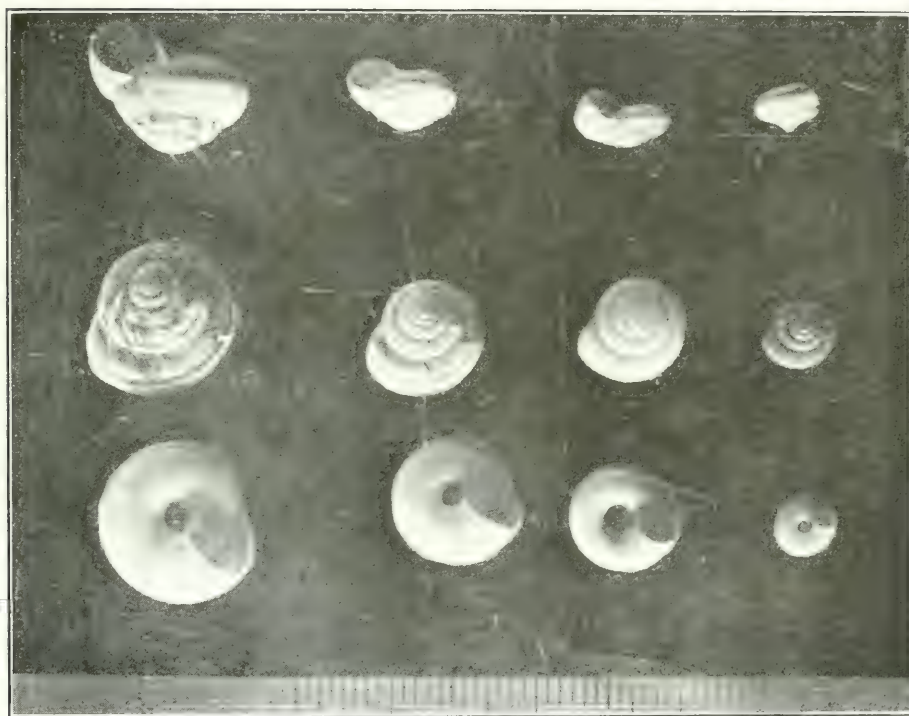


Arbor-vitae forest at the inlet of Sinyaleamun Lake. Photo by J. M. Hamilton.

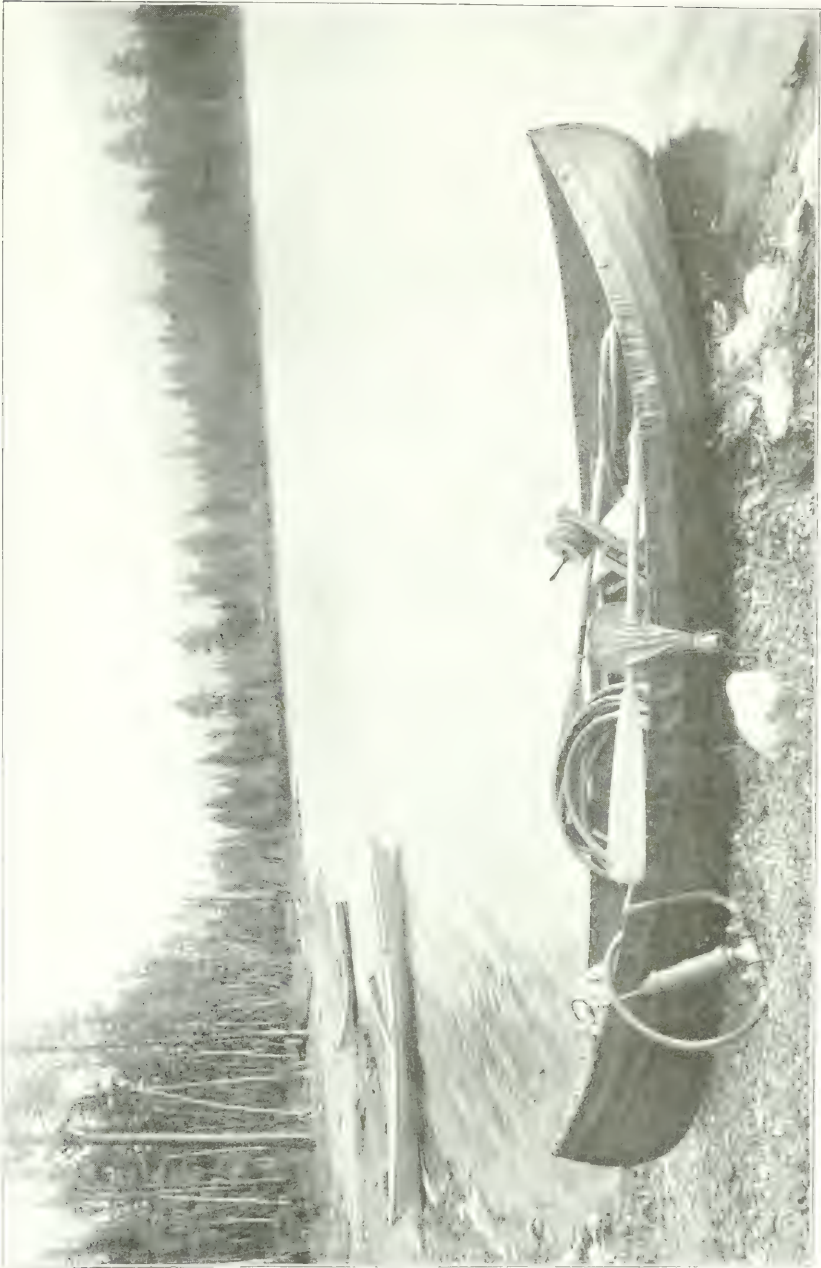


Cascade in Sinyaleamin Creek, a short distance above Sinyaleamin Lake. Photo
by J. M. Hamilton.





A series of shells showing the varieties of *Pyramidula Strigosa* due to high altitude. The largest, to the left, from McDonald Lake, altitude 3300 feet. The next size, from Tobacco Root Mountains, east of the main range. The third, from the Bitter Root Mountains, altitude 5000 feet. The smallest, from McDonald Peak, altitude 8000 feet. Photo by M. J. E.



Curvas boat Daphnia loaded with apparatus and ready for service. By permission of the Am. Mic. Soc. Photo by M. J. E.
View is at the outlet of Swan Lake, looking down the river, north.



General view of Mc Donald Peak. Mc Donald Peak is on the right. The bluffs of Fenton on the left. The view is from the outlet of the lake looking east. By permission of the Amer. Mic. Soc. Photo by M. L. F.

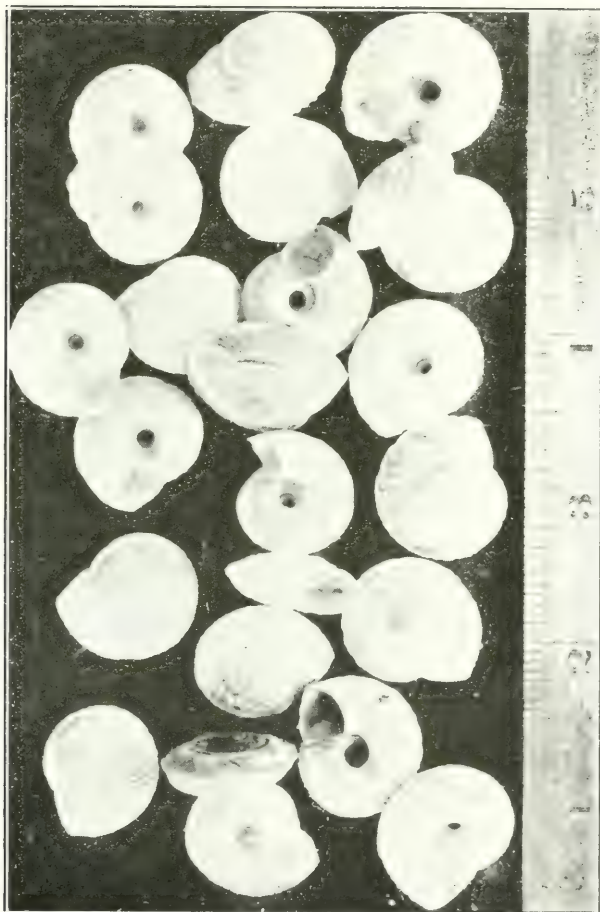




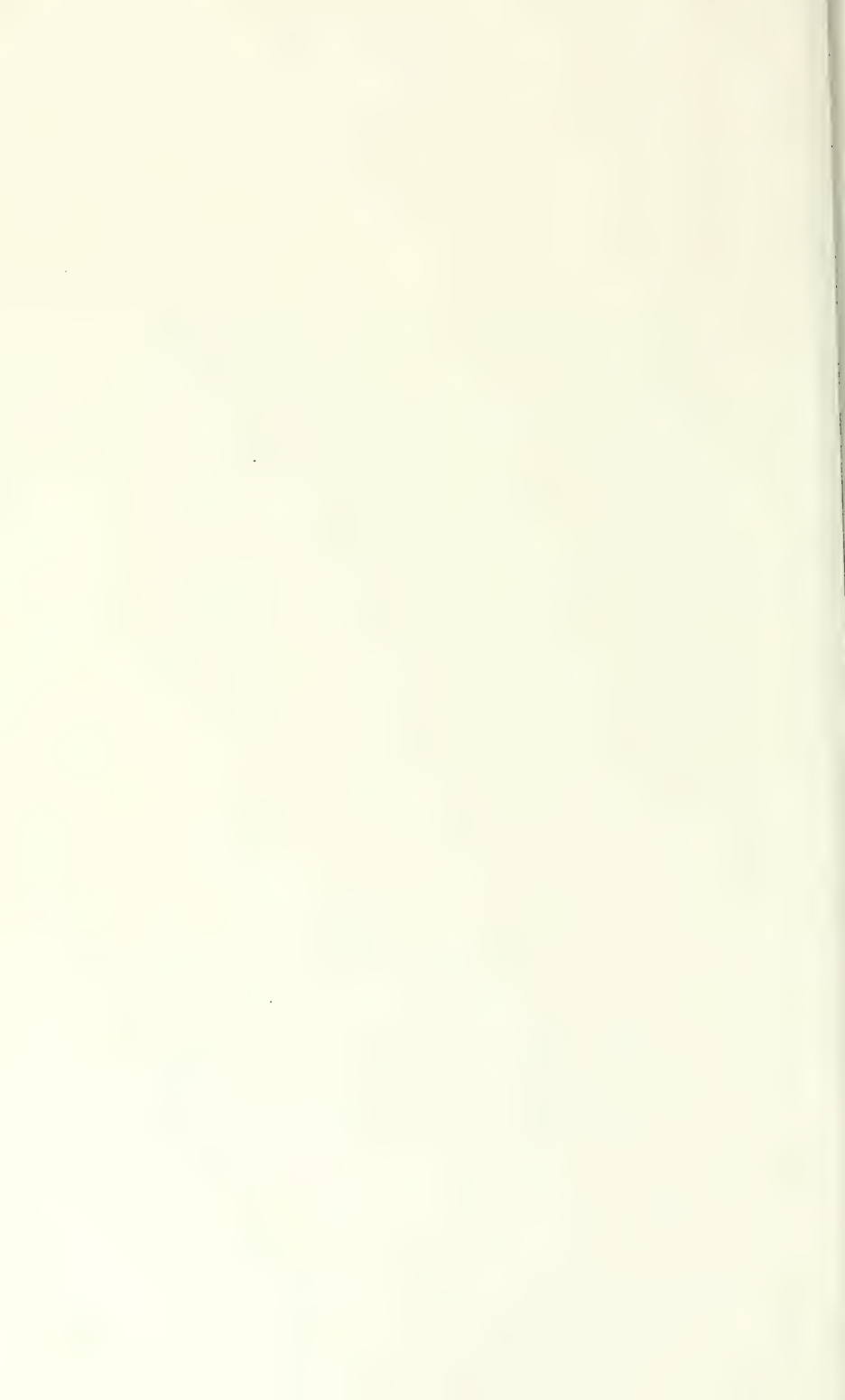
McDonald Lake, upper end, with McDonald Peak. Cedar forest in the foreground. The view is southeast. Photo by J. M. Hamilton

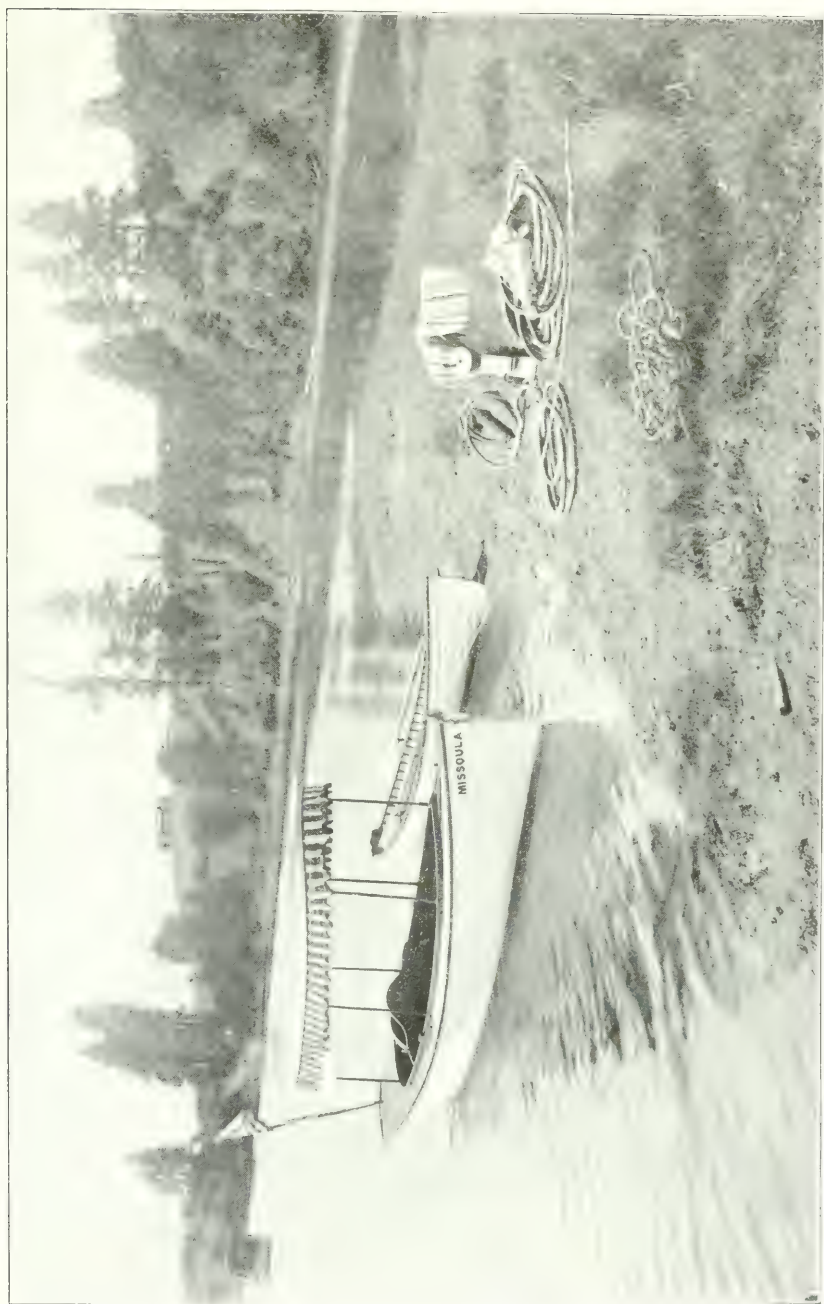


View southeast from MacDougal Peak. The lake in the foreground is MacDougal Lake. Silloway Peak is the double peak in the middle of the illustration. Craig Mountain is on the right in the distance. Photo by M. J. E.



Pyramidula elrodii Pilsbry. From mountain slopes north of McDonald Lake. Photograph made at the University of Montana by Frances Maley.



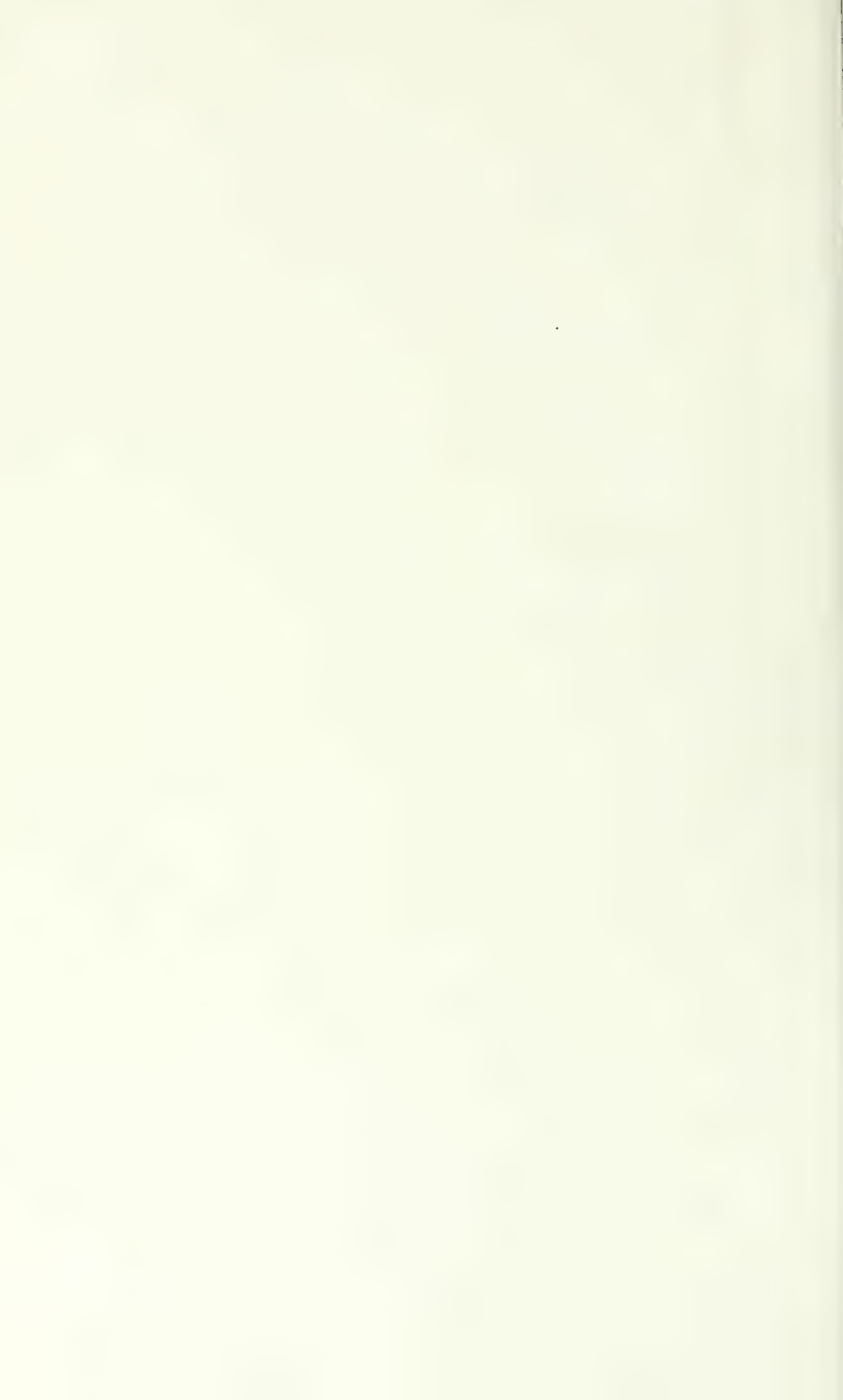


Equipment of the Station for work on the lake. The launch Missoula with rowboat Culex and equipment, in the harbor by the laboratory. By permission of the Amer. Mic. Soc. Photo by M. J. E.





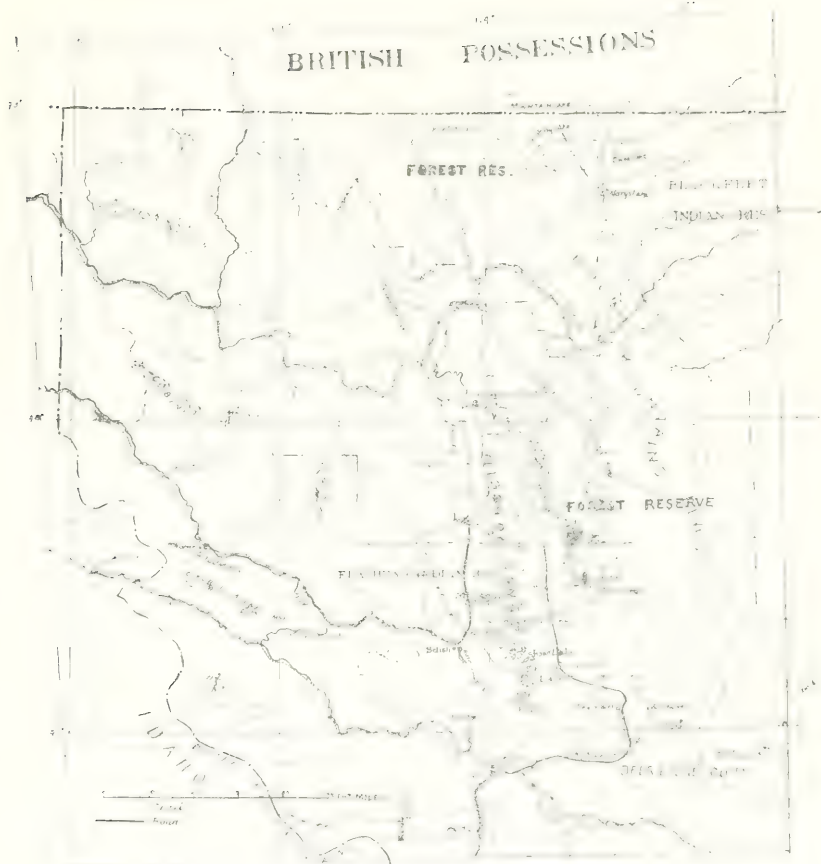
Making the ascent of McDonald Peak. Camp at 7800 feet in July. The spur on the left is from the main peak. See illustration with glacier, Plate XXXV. A glacier lies behind this spur. The shell, *P. strigosa*, var. *alpina*, was found on the shoulder above the camp, and up on a level with the snow. Note also the dead timber, killed by previous forest fires. Photo by Morton J. Elrod. The view is east.



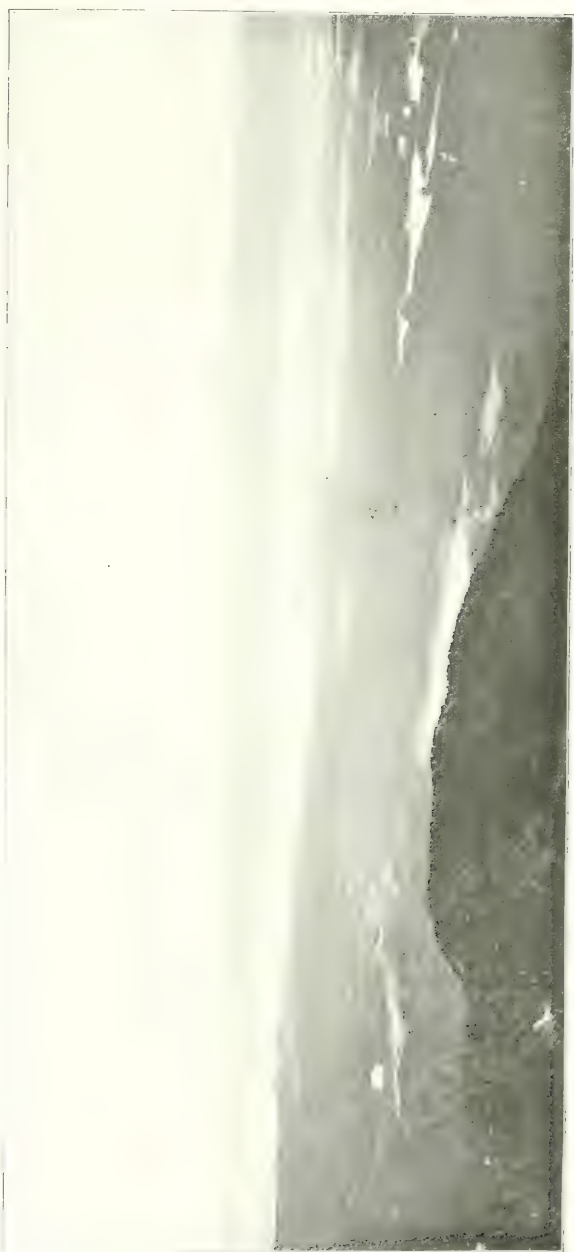


The main Peak of McDonald, with glacier and snow field, from the saddle between the two peaks. A snow field lies behind the spurs to the right and left of the main peak. U. S. G. S. Triangulation Station on the summit. The view is south of east. Photo by M. J. E.





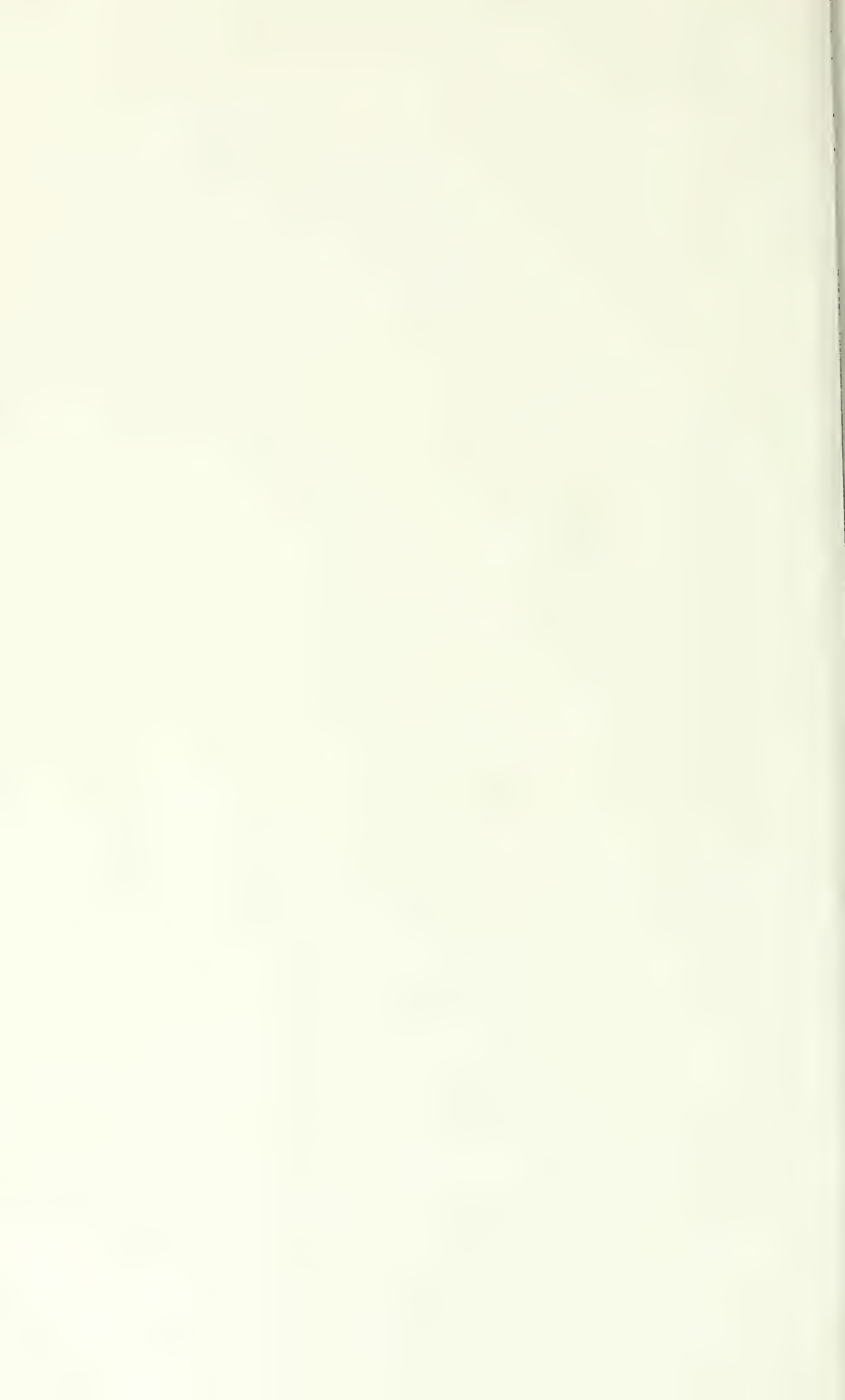
Map of the northwestern portion of Montana, in which is located the University of Montana Biological Station.



General view westward from the summit of MacDougall Peak. In the foreground is the wooded plain. Echo Lake is on the left. Rest Lake in the middle foreground, Swan River on the left. In the distance is Flathead Lake. The point of land extending into the lake is the delta of Flathead River. Photo by M. J. E.



Dodge Mountain, from the Summit of MacDougal Peak. The view is south of east. Beyond Dodge Mountain is the valley of the South Fork of the Flathead River. In the distance is the main range of the Rockies. Photo by M. J. Elrod, in July, 1901.





Craig Mountain, from Silloway Peak. View is from its eastern side, showing the long crest with several summits. Wolf Creek heads in the snow visible. On the left is a series of faults, swept clean and smooth by sliding snow. Photo by Maurice Ricker.



Collecting party with packs, on the summit of Silloway Peak, showing mode of carrying loads in mountain work. Craig Mountain in the background. The view is south. Photo by Maurice Ricker.



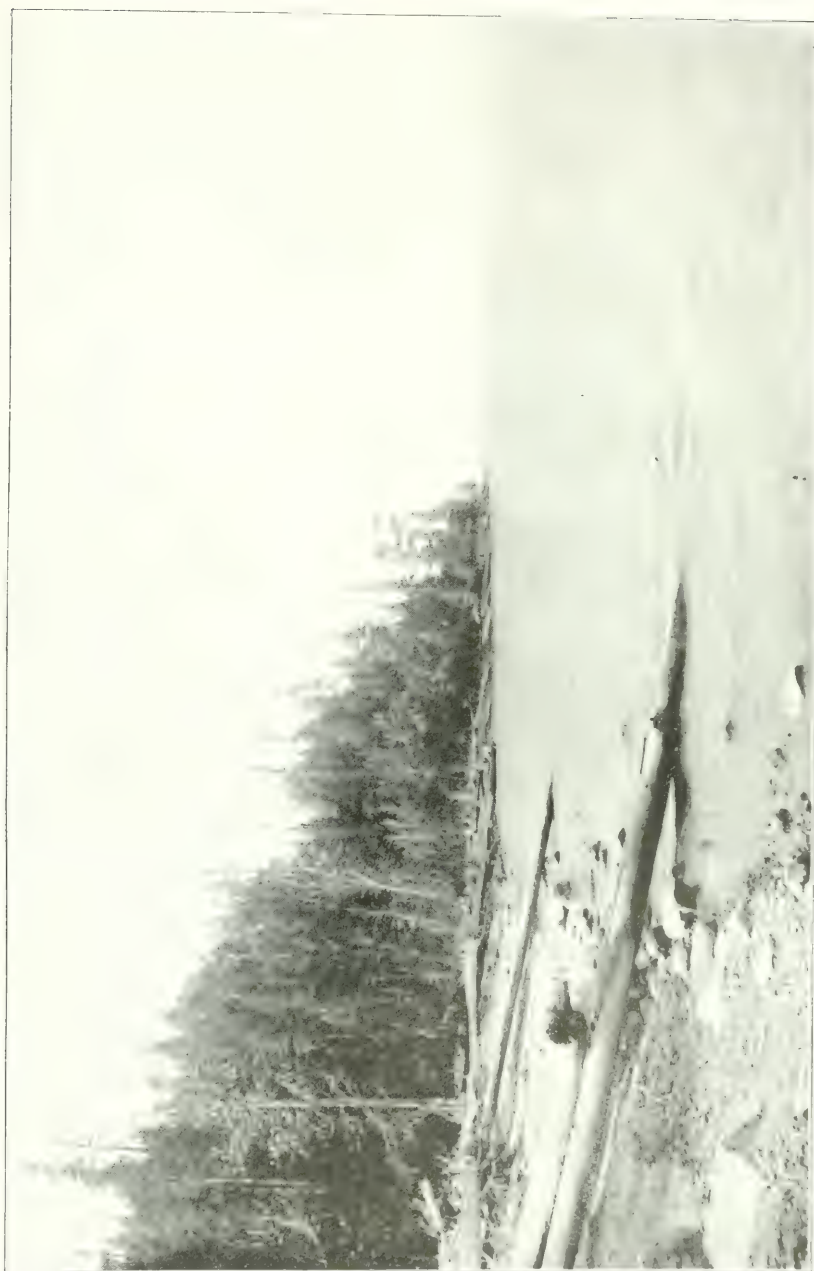


Showing sleeping bags as used in mountain work.



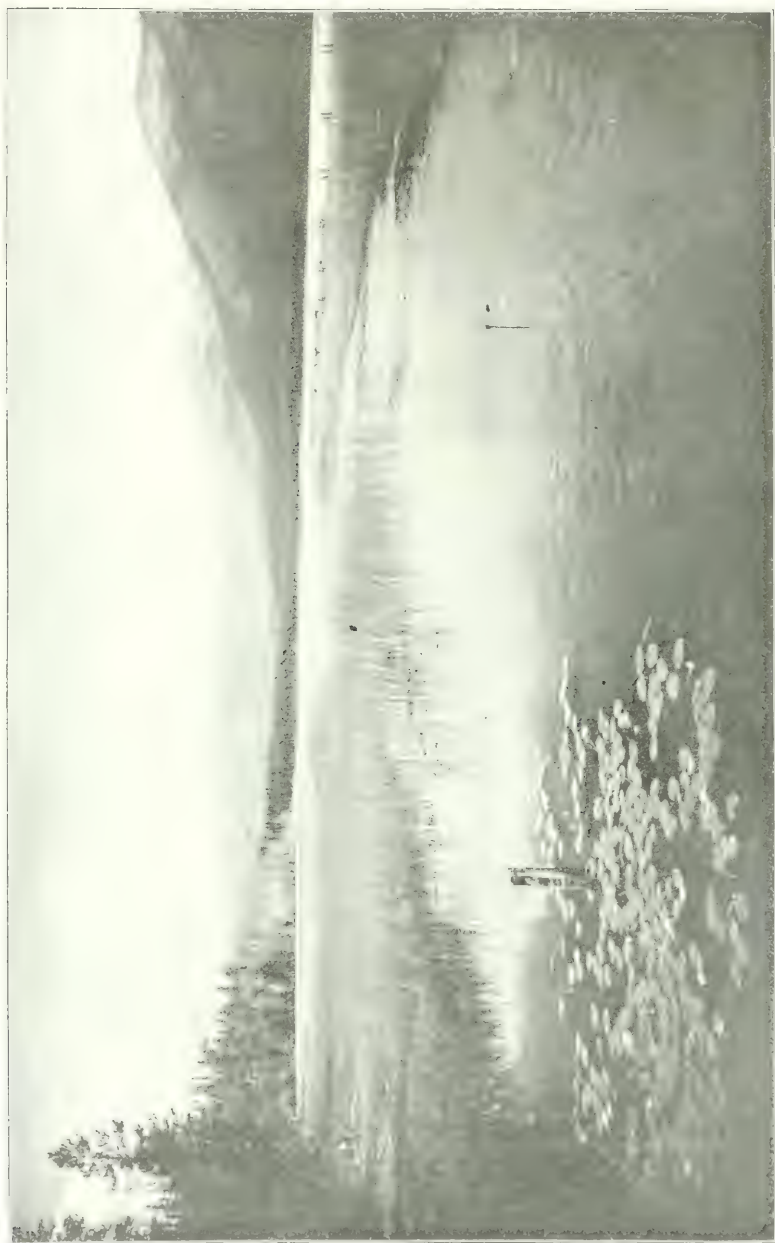


A portion of Echo Lake, showing submerged cabins and timber land. The bridge is the place at which the new hydra was found. The view is north. The portion shown is "new lake" made by the permanent elevation of lake level. Photo by M. J. E.

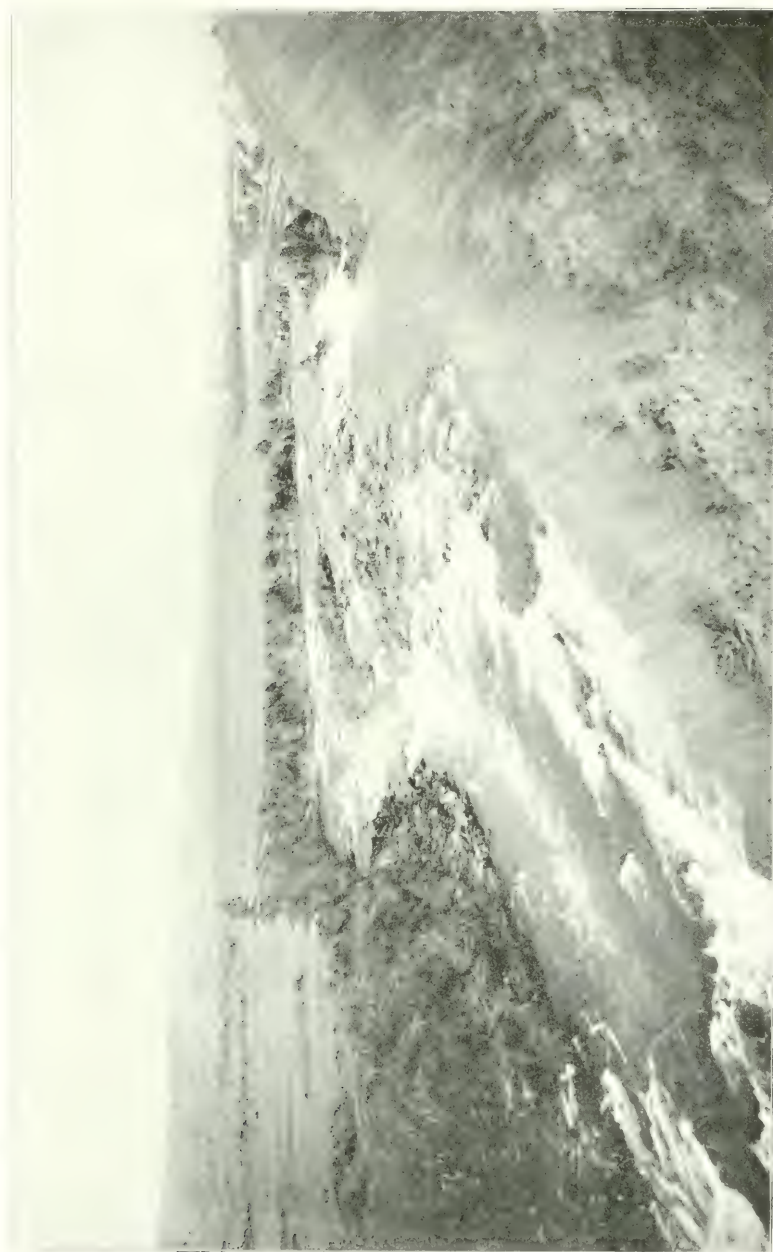


A view of the head of Flathead Lake near the Station, showing general character. The view is south. Photo by Mr. J. M. Hamilton. By permission of the Am. Mic. Soc.

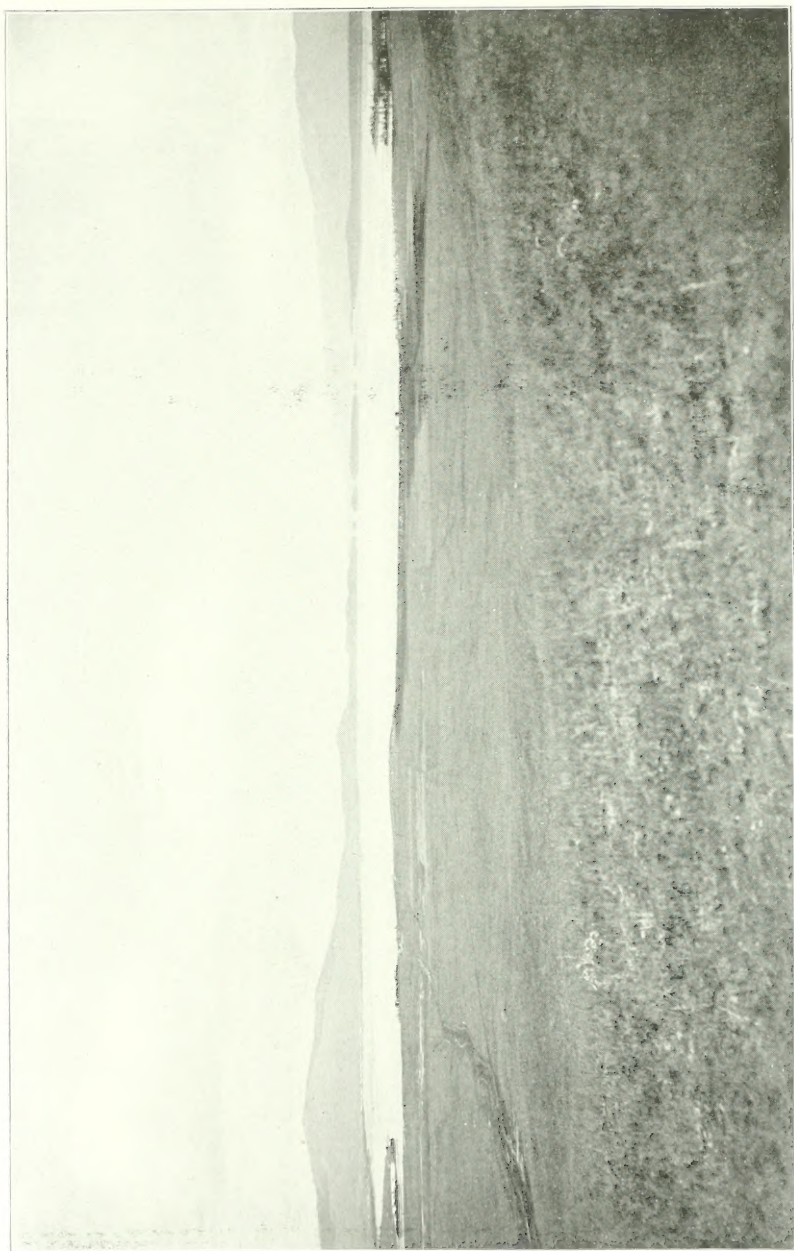




General view of Rost Lake from the outlet. The Swan Range of the Kootenais is in the distance. The view is east of north. Photo by M. J. E.



Rapids in the Pend d'Oreille River, showing the fall and rapid cutting of the river. This is about two miles from the lake. View is taken from the moraine bank. The large rock which it was intended to remove is plainly visible in the middle of the stream in the right of picture. The view is north. Photo by M. J. E.



View of Flathead Lake from the Moraine at the foot of the lake. The lake is about two miles distant from the point of view. In the distance is seen the islands which cut the lake in two. The main lake lies beyond these islands. To the left is the outlet, the Pend d'Oreille River. The view is north. Photo by M. J. E.

